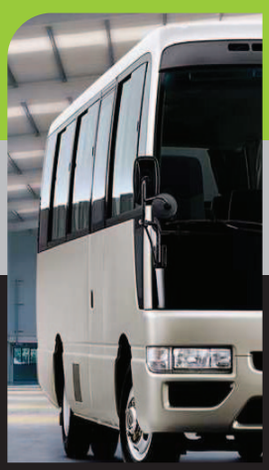

SERVICE MANUAL

Valeo TM31 Compressor

valeo added™

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Valeo

Foreword

This service manual has been elaborated to help service personnel to provide efficient and correct service and maintenance on the **TM31** (formerly called DKS 32) compressor (for HFC-134a) for automotive air conditioning.

This manual includes the operation specifications, procedures for disassembly, reassembly, and inspection of the compressor.

The contents of this manual, including illustrations, drawings and specifications were the latest available at the time of printing.

Valeo Japan reserves the right to make changes in specifications and procedures at any time without notice.

VALEO JAPAN CO., LTD.

WARNINGS

The following warning signs are used in this service manual.
These are extremely important to ensure safe operation and to prevent body injuries and property damage.
They must be fully understood before starting the air conditioner maintenance.

WARNING! Maintenance must be properly done to avoid serious injury risks.

CAUTION! Improper maintenance can result in injury or property damage.

MEANING OF MARKS

The following marks are used in this service manual to facilitate correct air conditioner maintenance.

Advice Procedures necessary to ensure the best air conditioner maintenance.

Note Information to optimize the air conditioner maintenance.

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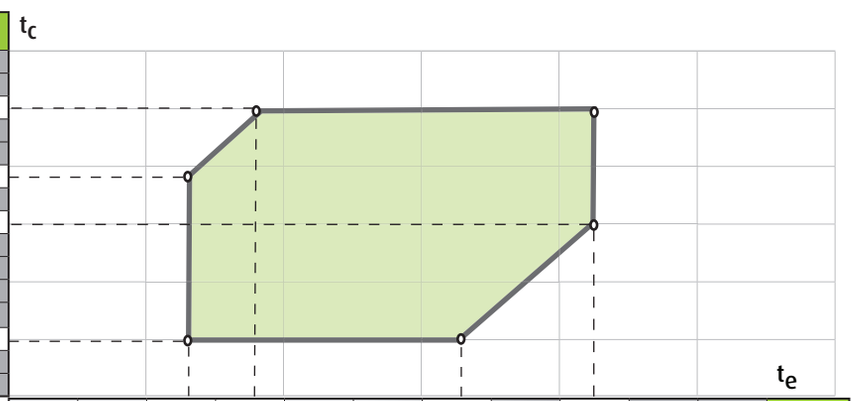
Compressor

MODEL	TM31
TECHNOLOGY	Heavy Duty Swash Plate
DISPLACEMENT	313 cc (19.1 cu in) per rev.
NUMBER OF CYLINDERS	10
REVOLUTION RANGE	700-6,000 rpm (maximum peak : 7,000 rpm)
DIRECTION OF ROTATION	Clockwise viewed from clutch
BORE	36 mm (1.42 in)
STROKE	30.7 mm (1.21 in)
SHAFT SEAL	Lip seal type
LUBRICATION SYSTEM	Lubrication by gear pump
REFRIGERANT	HFC-134a
OIL (QUANTITY)	ZXL 100 PG PAG OIL (DH-PS): 500 cc (30.5 cu in)
WEIGHT	9.5 kg (21 lb) (w/o Clutch w/o oil)
DIMENSIONS (with clutch) Length - Width - Height	278.5 - 143 - 178 (mm) 10.94 - 5.63 - 7 (in)
MOUNTING	Direct (side or base)

Valeo **TM31** Application limits for HFC-134a

Saturated condensing conditions

PSIA	PSIG	°F	MPaA	MPaG	°C
358	343	**171**	2.47	2.37	**77**
244	229	**140**	1.68	1.58	**60**
191	177	**122**	1.32	1.22	**50**
100	85	**79**	0.69	0.58	**26**



		-17	-10			5		14			°C
		0.05	0.10			0.25		0.37			MPaG
		0.15	0.20			0.35		047			MPaA
		1	14			41		57			°F
		7	14			36		54			PSIG
		22	29			51		69			PSIA

Saturated evaporating conditions

t_c : Condensing temperature
t_e : Evaporating gas temperature

Specifications※

TYPE	Electromagnetic single-plate dry clutch
RATED VOLTAGE	24V DC or 12 V DC
POWER CONSUMPTION	48 W maximum
STATIC TORQUE	78 N·m {8.0 kgf·m, 58 lbf·ft}
DIRECTION OF ROTATION	Clockwise, viewed from clutch
WEIGHT	Approx 4.5 kg {10 lb}
V-BELT TYPE	V-groove (A or B) or V-ribbed (PK)

※The above specifications may vary with the compressor.

1- Product description - Performance

The performance data below were measured under the following conditions:

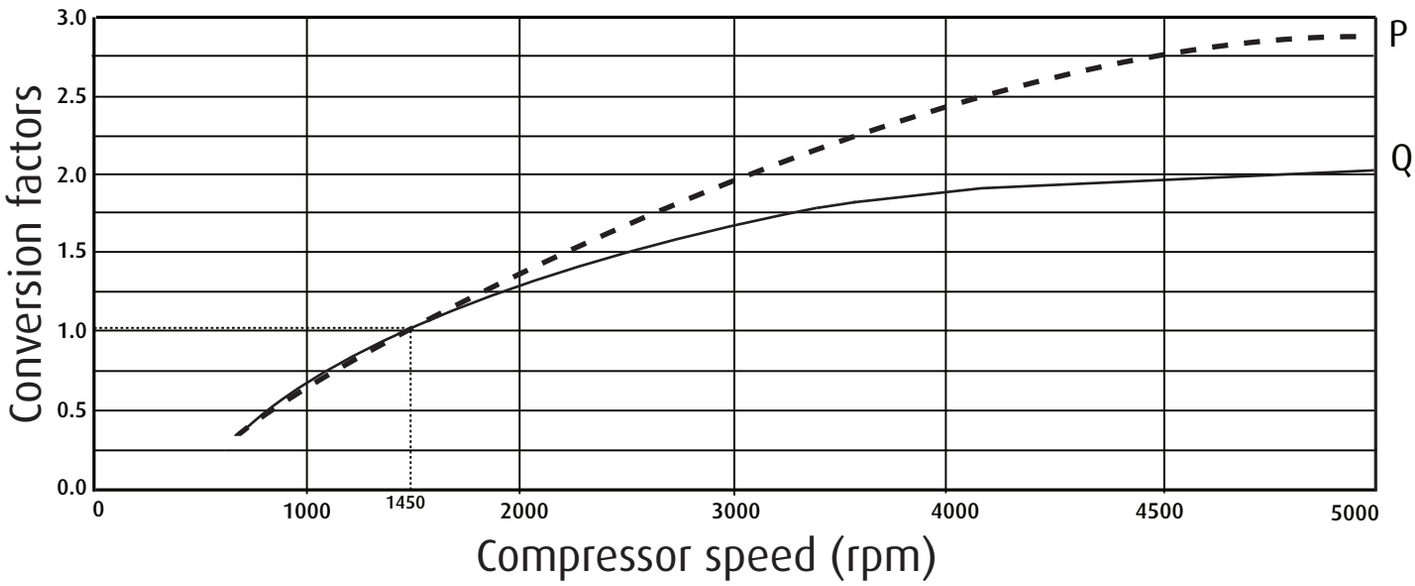
- Compressor speed: 1450 rpm
- Suction gas temperature: 20°C

Valeo **TM31** performance data (R134a)

Conditions			Cooling capacity Q (kW) & Power consumption P (kW)						
Cond temp (°C)	Pd (MPaG)	Evap temp (°C)	12.5	10	7.5	5	0	-5	-10
		Ps (MPaG)	0.35	0.32	0.28	0.24	0.19	0.15	0.10
40	0.91	P (kW)	4.00	3.90	3.81	3.64	3.44	3.19	2.85
		Q (kW)	19.83	18.19	19.17	14.11	11.61	9.48	7.06
50	1.21	P (kW)	4.59	4.50	4.33	4.14	3.82	3.51	3.00
		Q (kW)	17.35	16.01	14.17	12.38	10.09	8.25	5.99
60	1.58	P (kW)	5.18	5.03	4.78	4.50	4.09	3.73	3.20
		Q (kW)	14.90	13.62	12.06	10.34	8.39	6.83	4.85

Valeo **TM31** conversion factors

Power consumption data at different rotation speed can be approximated with the conversion factors below.

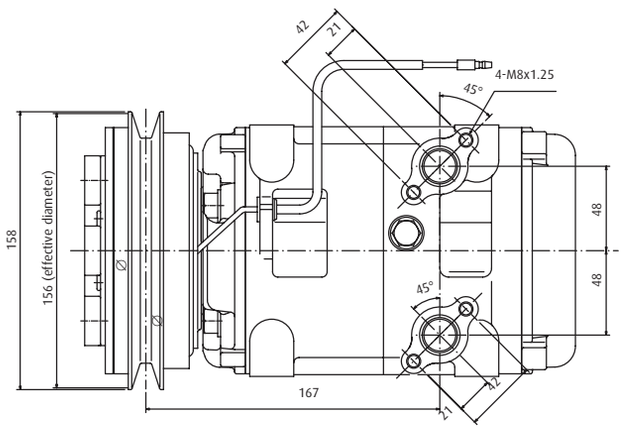


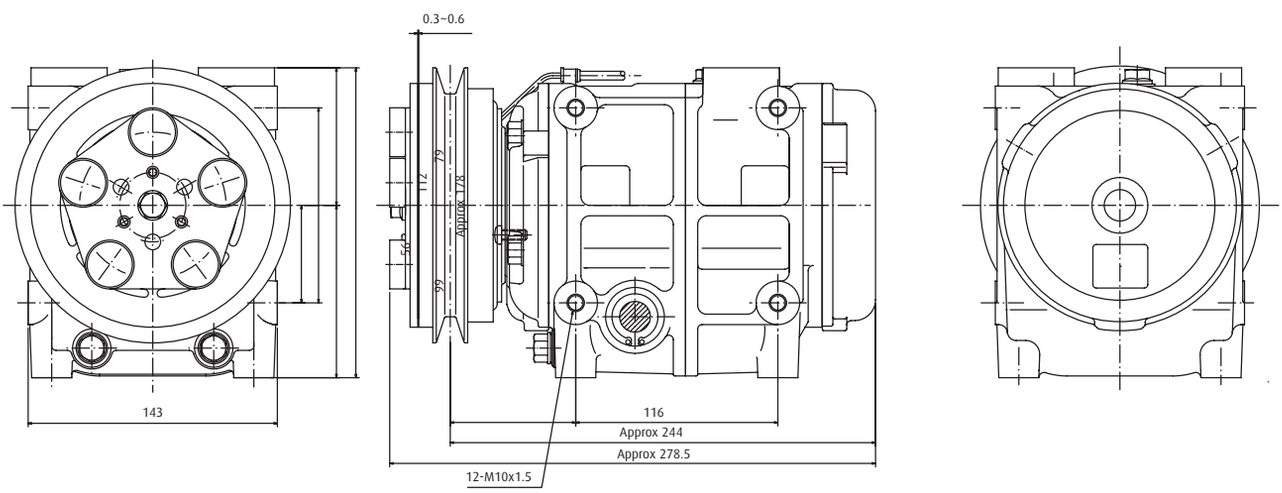
- **Lip-seal type shaft seal**

The compressor has a lip-seal type shaft seal. This type of shaft seal greatly improves the sealing of the compressor to increase its performance and durability.

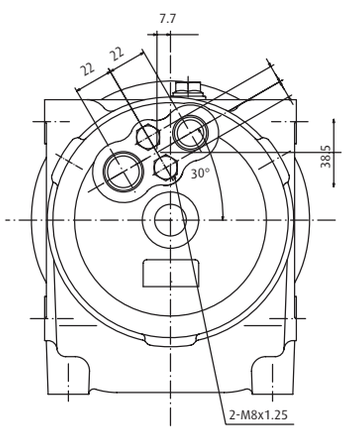
TM31 compressors with magnetic clutch

Unit: mm

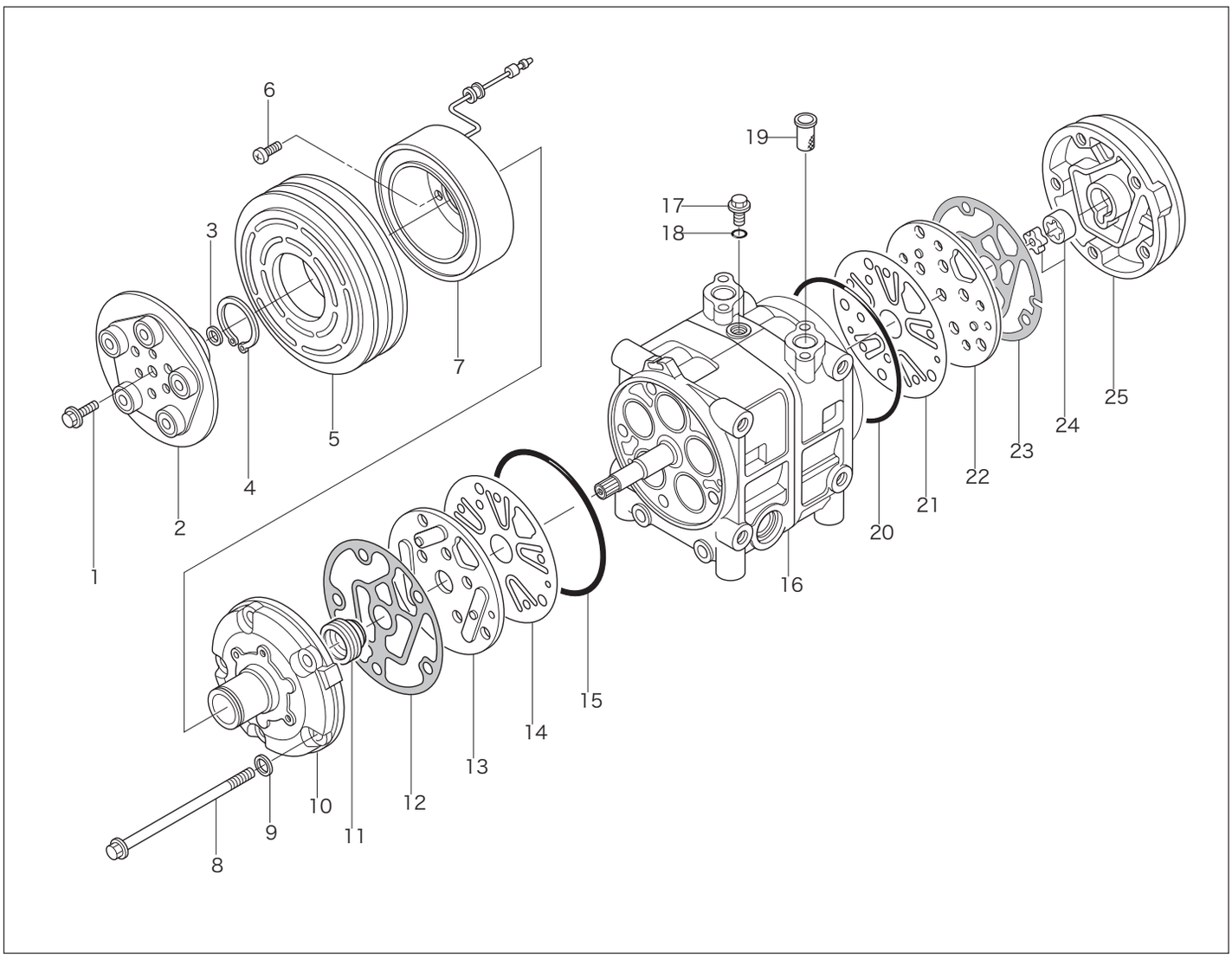




Other connecting type



1- Product description - Exploded view



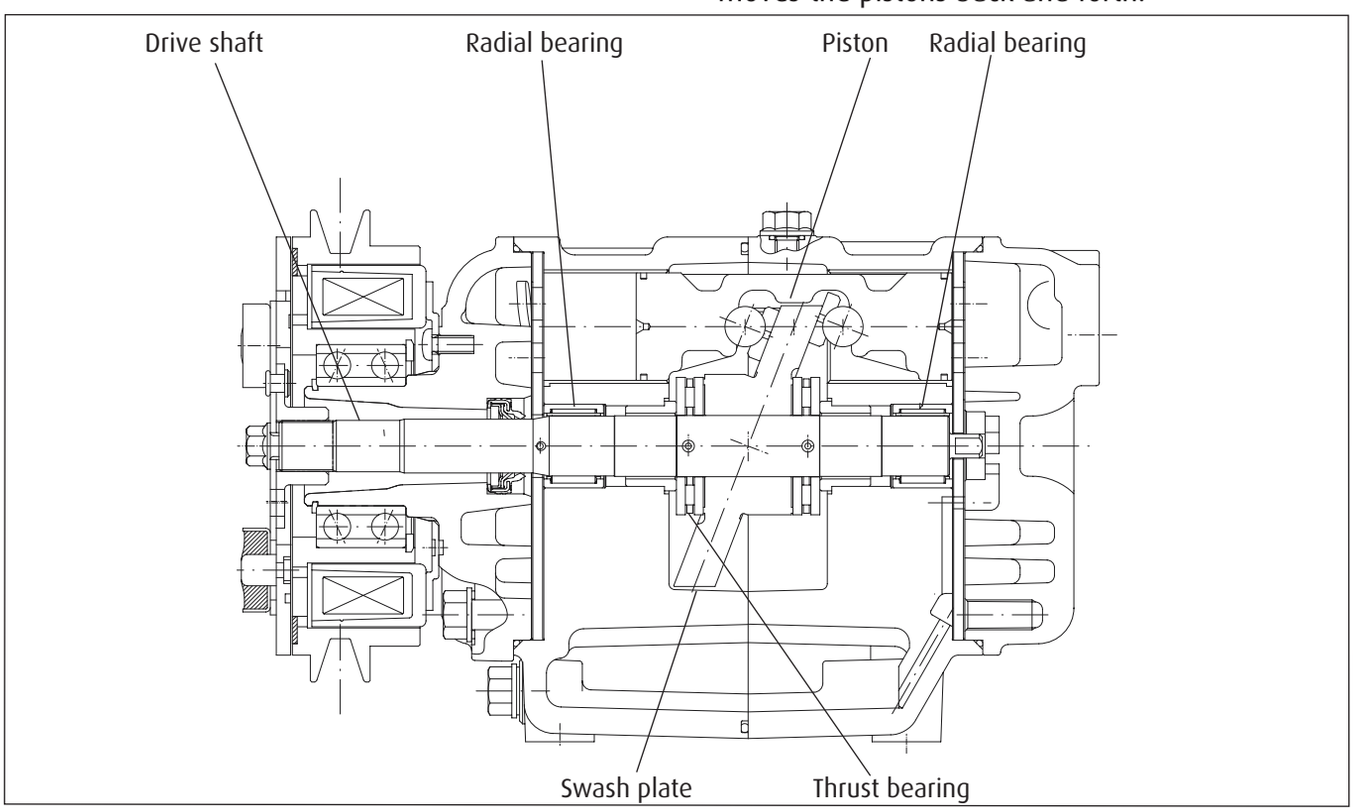
1. Center bolt
2. Armature assembly
3. Adjusting shim
4. Snapring
5. Pulley assembly
6. Screw
7. Field coil
8. Bolt
9. Washer
10. Front cylinder head
11. Shaft seal assembly
12. Gasket
13. Valve plate assembly
14. Suction valve
15. O-ring
16. Cylinder shaft assembly
17. Oil filler plug
18. O-ring
19. Strainer (option)
20. O-ring
21. Suction valve
22. Valve plate assembly
23. Gasket
24. Gear pump
25. Rear cylinder head

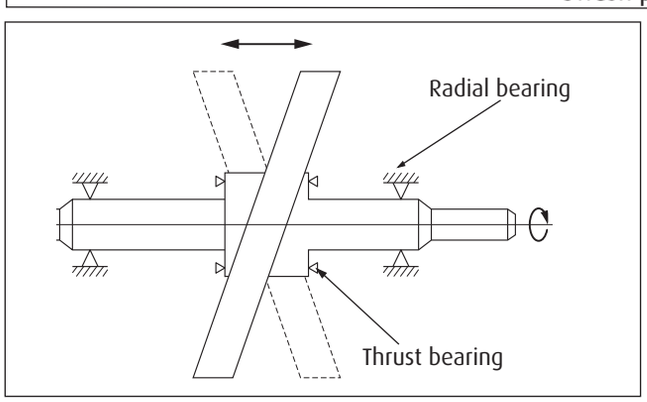
1- Product description - Swash plate system

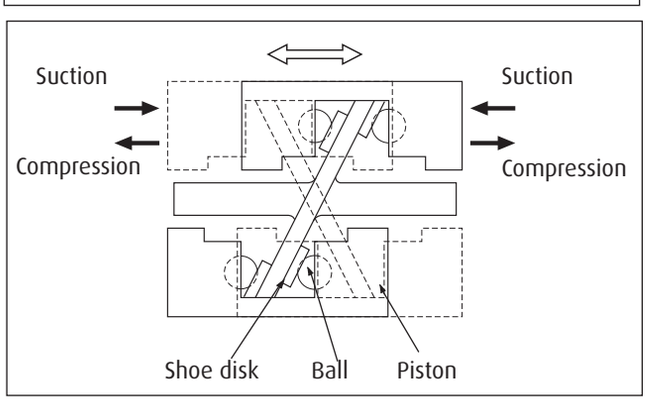
Valeo **TM31** are 10-cylinder swash plate type compressors. With this type of compressors, the cylinders and pistons are arranged axially along the drive shaft.
The pistons operate within the cylinders and are driven by a swash plate to perform suction, compression and discharge.

Swash plate system

The drive shaft, which is driven by the engine through the magnetic clutch, is equipped with a swash plate.
The drive shaft is supported by two radial bearings and two thrust bearings.
The swash plate is rotated by the drive shaft, and moves the pistons back and forth.







Piston drive system

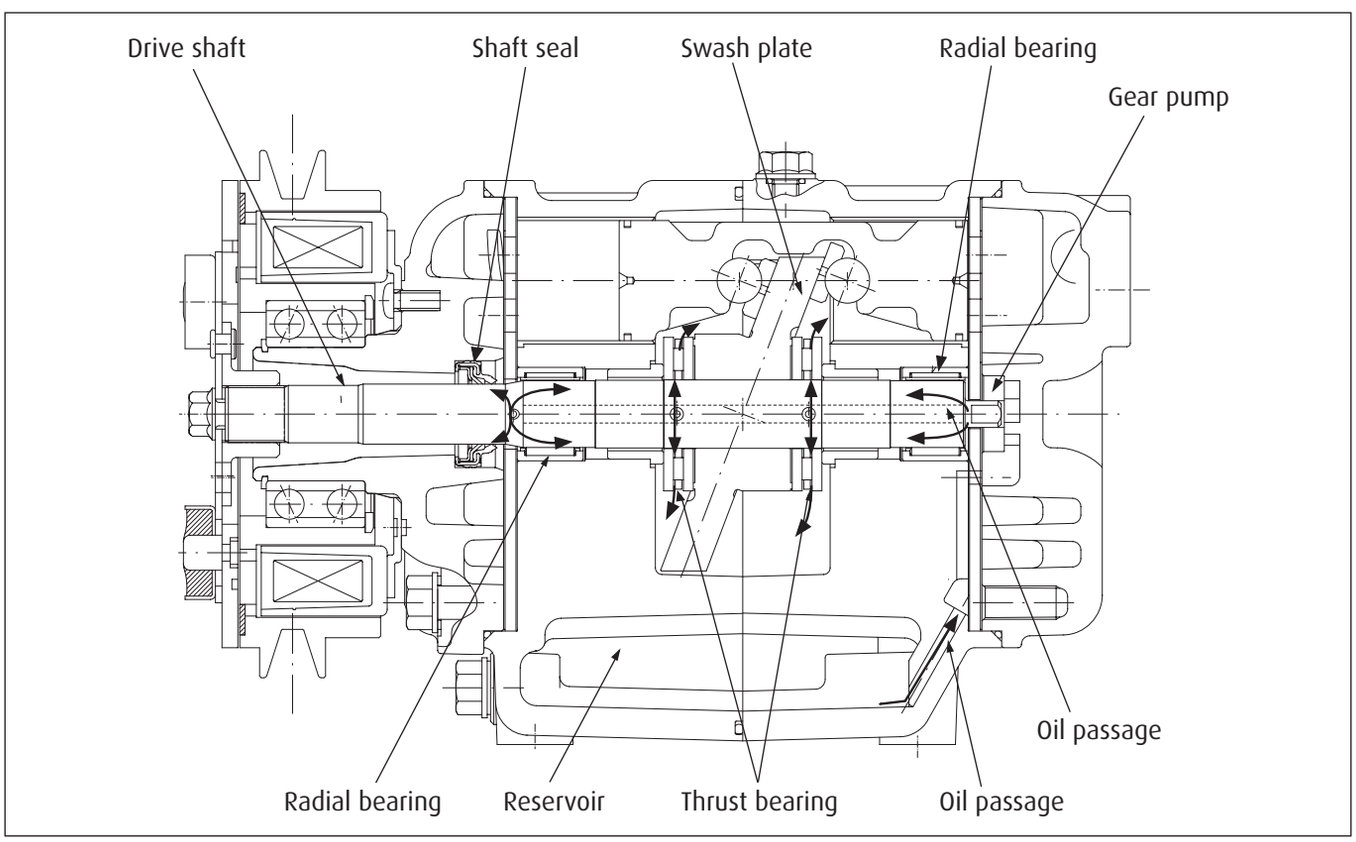
The pistons in the cylinders are mounted on the swash plate through a drive ball and a shoe disk. Each piston has a compression head at each end. The rotation of the swash plate rotation results in a reciprocating piston movement parallel to the drive shaft.
The cylinders, which are arranged at 72° intervals around the drive shaft, are each divided into 2 chambers, providing 5 front and 5 rear bores.
As each piston performs suction and compression at either end, the compressor operates as a 10 cylinder compressor.

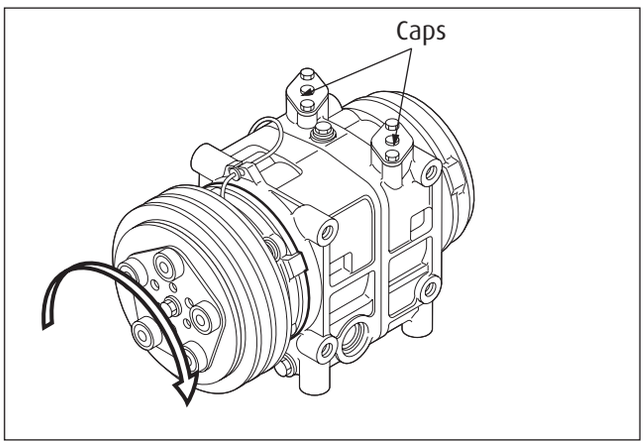
The compressor is lubricated by a gear pump in the rear cylinder head which is connected to the compressor.

Oil flow

When the compressor starts operating, the gear pump draws oil from the reservoir and pumps it through an oil passage in the shaft.
The oil then flows through ports in the shaft to lubricate the bearings and the shaft seal.

The area between the swash plate and the shoe disks is lubricated by the splashing action of the oil flowing through the thrust bearings.
Oil also flows through ports in the pistons to lubricate the cylinders and the pistons.





Compressor

1. The direction of rotation is clockwise as viewed from the clutch side.
2. Each compressor is delivered filled with a specified quantity of compressor oil as described on its label. The total amount of oil your air conditioning system requires is provided by the system designer or supplier.

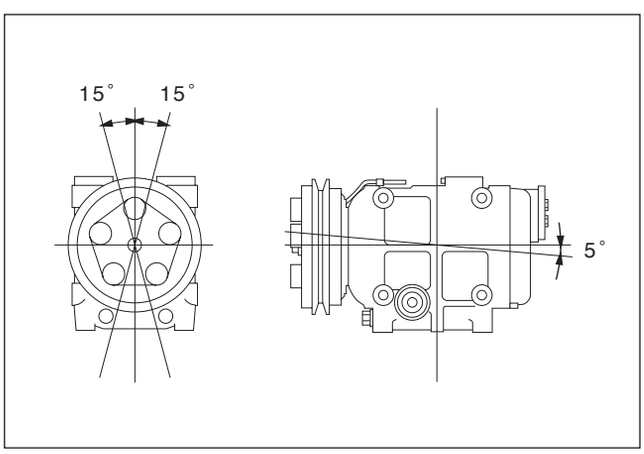
Operation conditions table

Item	Condition
Surrounding temperature	Under 120°C (248°F)
Speed	Maximum: 7,000 rpm Continuous: 6,000 rpm
Pressure	Maximum: 2.4 MPaG {24.5kgf/cm^2,348 psig}

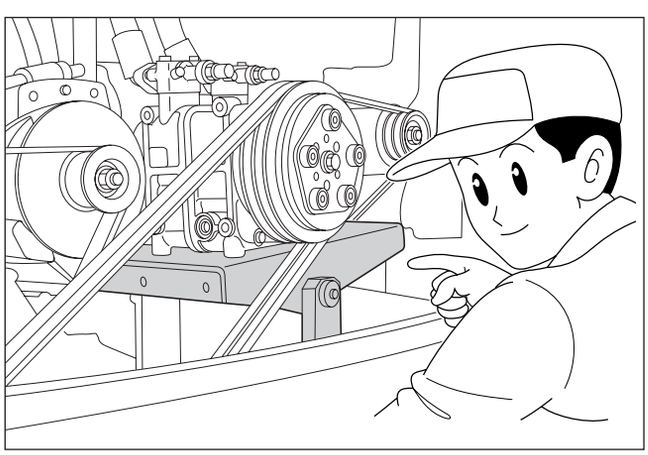
3. The compressor must be operated under the conditions shown in the operation conditions table shown at the left.

CAUTION!

The A/C cycle components must be designed so that the pressure in the cycle does not exceed 2.4 MPaG {20 kgf/cm^2, 348 psig}.

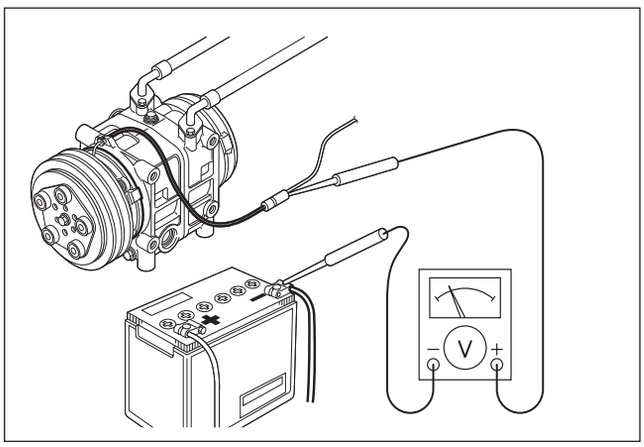


4. Inclination limit at installation
   The compressor must be installed on the vehicle within the inclination range shown at the left.



Compressor bracket

1. Install the bracket securely on the chassis frame or engine body. As the engine vibrations may be severe, the bracket and mounting bolts must be installed securely.
2. Vibration resistance
   There must not be any resonance under 250 Hz.

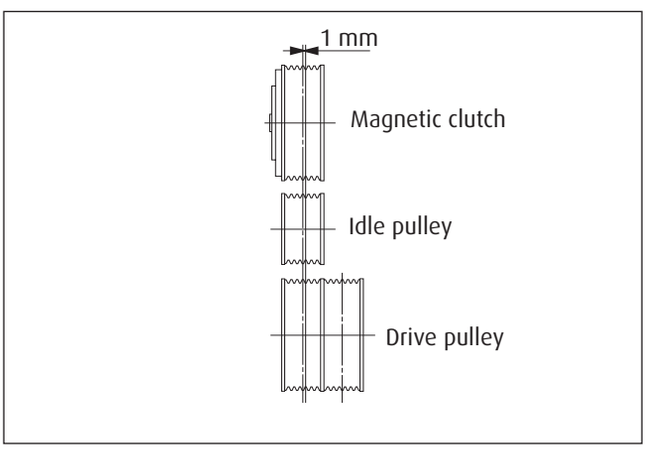


Magnetic clutch

1. Voltage

   DC 24 V
   The terminal voltage of the magnetic clutch must exceed 21 V.

   DC 12 V
   The terminal voltage of the magnetic clutch must exceed 10.5 V.



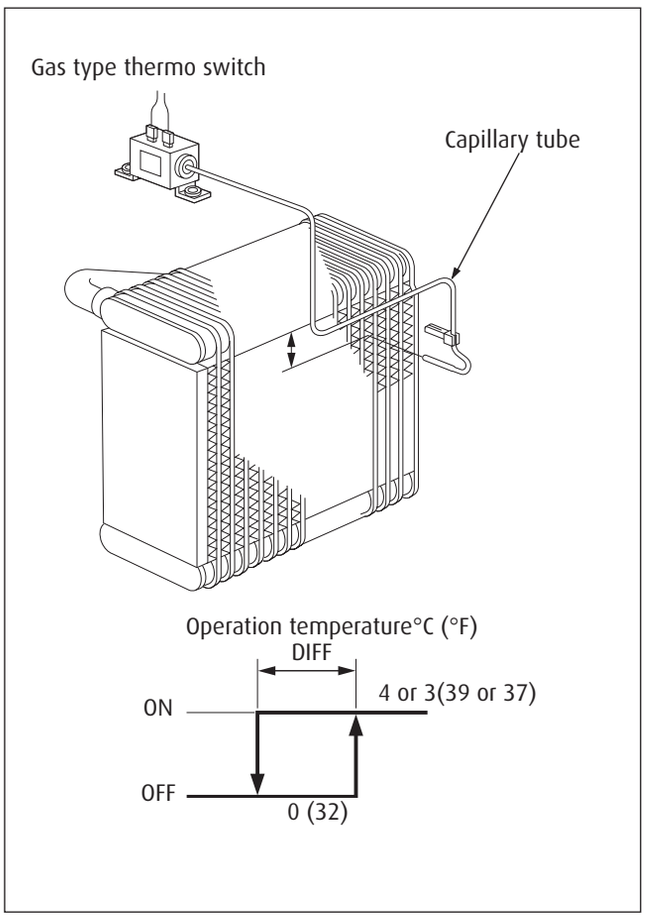
2. Ratio of magnetic clutch to drive pulley

- When the compressor is driven from the pulley drive of the vehicle, the magnetic clutch to drive pulley ratio should avoid the range 1: 0.92-1.08 to limit vibration and resonance.
- Compressor speed must not exceed the specified speed.

CAUTION!

Pulley ratio is the ratio of the magnetic clutch diameter to the drive pulley diameter.

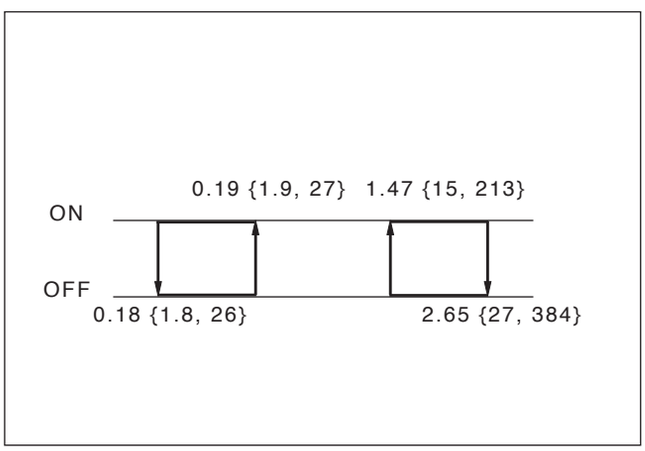
3. Pulley alignment tolerance is less than 1mm (0.04 in).
4. Pulley groove: V-groove or V-ribbed.
5. The belt tension must be adjusted to the tension specified by the belt maker.



Control switches

1. Thermo switch

A thermo switch is necessary. The following specification is recommended.
Compressor OFF:
Evaporator fin surface temperature of 0°C (32°F) or below.
The thermo switch is used to prevent the evaporator from freezing.



2. Dual pressure switch

A dual pressure switch is necessary.
The following specifications are recommended.
Compressor OFF

- High pressure control
  2.65 MPaG {27 kgf/cm^2, 384 psig} or higher
- Low pressure control
  0.18 MPaG {1.8 kgf/cm^2, 26 psig} or lower

The dual pressure switch controls high and low pressure.

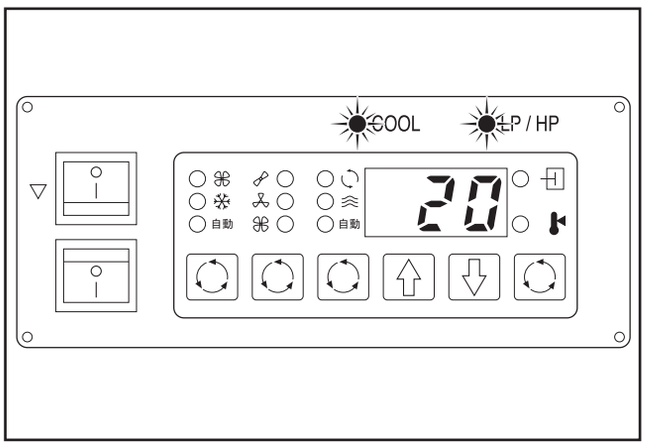
- High pressure control

When abnormally high pressure develops, the compressor is turned OFF to protect the system.

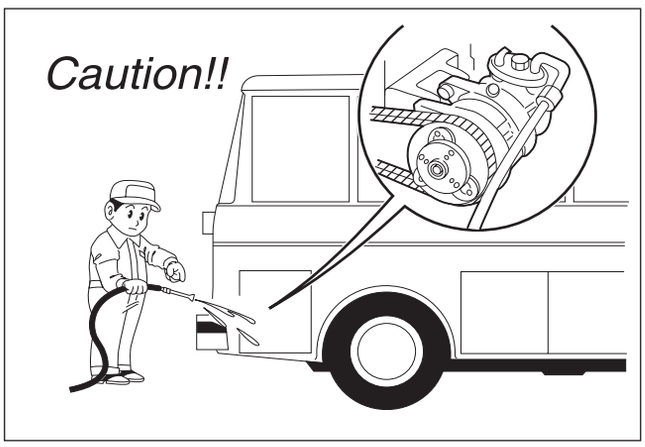
- Low pressure control

When there is insufficient refrigerant in the system, compressor operation is stopped to prevent the compressor from seizing.

2- Operation precautions

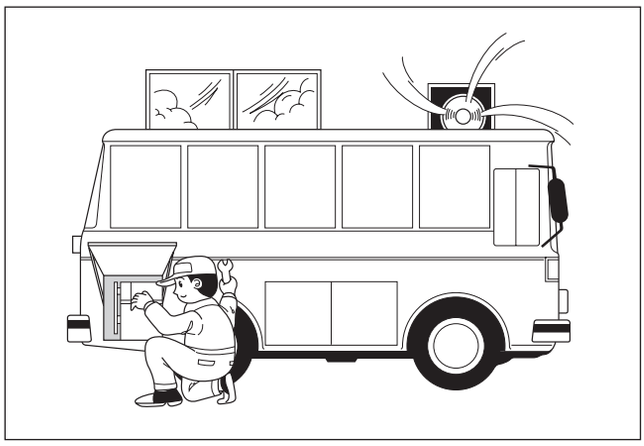


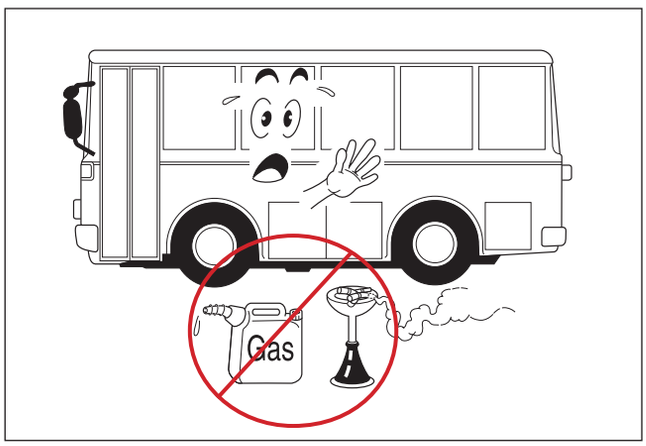
1. During the off season of the air conditioner, operate the compressor for a few minutes once a week.
2. Do not drive through water. Water may damage the magnetic clutch, thus preventing normal operation.

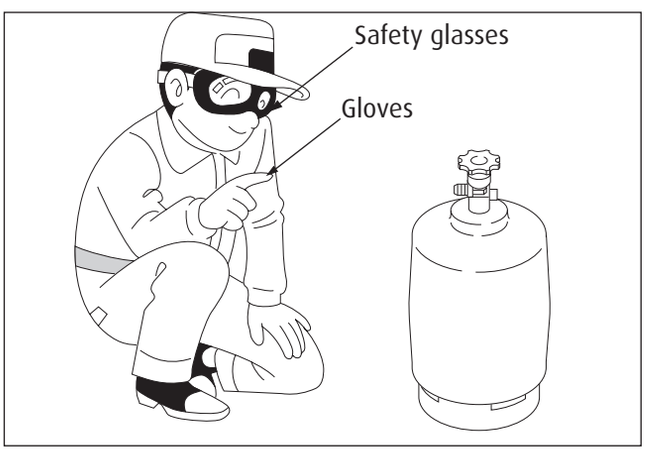


3. Do not allow a compressor that has not been used for a long period to become wet.
4. Always charge the A/C system with the specified quantity of refrigerant.
5. Keep the compressor clear of water projection while cleaning the vehicule.

3- Handling instructions







Maintenance precautions

Work area

As the components of air conditioners are particularly sensitive to moisture, dirt and rust, always observe the following:

- Work indoors whenever possible
- Select a flat ground work area
- Keep the work area clean
- Select a work area with adequate ventilation.

CAUTION!

Refrigerant itself is not harmful, but excessive accumulation in a closed area can cause oxygen deficiency.

- Keep open flame and inflammables away from the vehicle in which the air conditioner is being installed.
  (Fire is particularly dangerous during the gas leak inspection following installation)

WARNING!

Contact with flame and high temperatures can generate toxic gases.

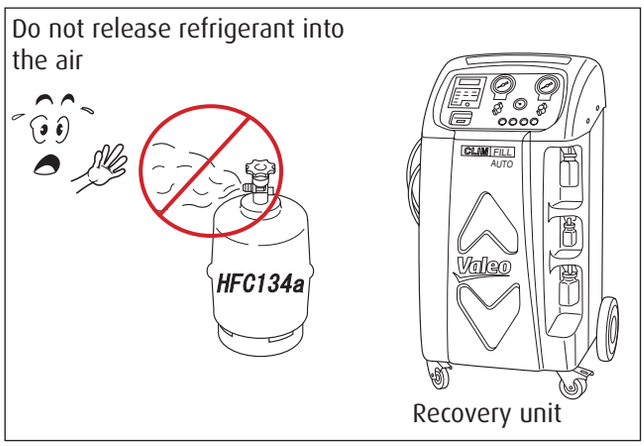
Refrigerant handling

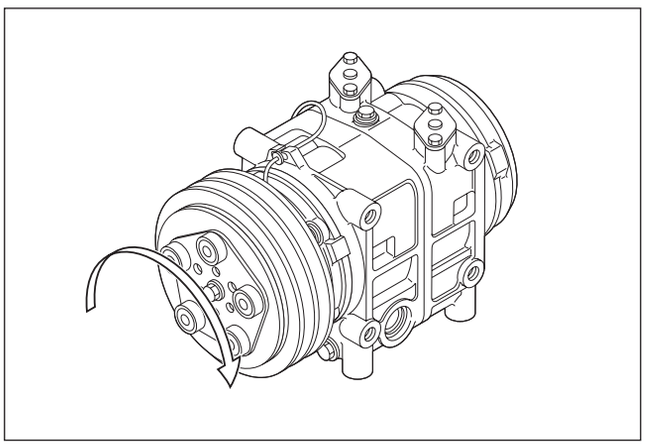
WARNING!

Direct contact with refrigerant can cause frostbite or blindness.
Always wear safety glasses and protective gloves.
Do not work with refrigerant close to your face.

1. Do not misidentify refrigerants

If an HFC-134a air conditioning system is mistakenly charged with another refrigerant, serious problems such as compressor seizing may occur. Therefore, confirm before charging with refrigerant that the type of air conditioning system is an HFC-134a system.





2. Do not release refrigerant into the air
Although HFC-134a is not subject to CFC regulations, it can have effect on global warming and so should not be released into the air. When removing refrigerant from the air conditioning system, always use a refrigerant recovery unit made specifically for HFC-134a.

Compressor handling

Do not strike or unecessarily turn the compressor upside down. If the compressor is knocked over or turned upside down during handling or installation, rotate the armature plate 5 or 6 times to circulate the oil.
Otherwise, oil in the cylinder during compressor start-up will cause valve damage and reduce durability.

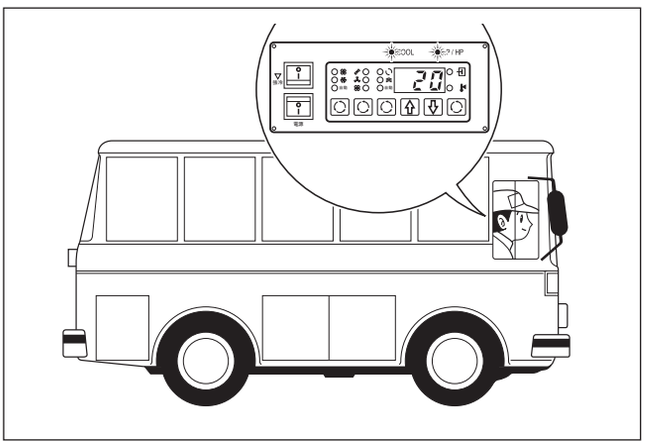
Compressor removal

When the compressor is operational

1. Perform the oil return operation (see p.16).
2. Recover the refrigerant from the system using a refrigerant recovery unit.
3. Remove the compressor.
4. Drain the oil from the compressor and close all open connections immediately.
5. Check the oil quantity and the degree of contamination (see p.17).

When the compressor is inoperable

1. Recover the refrigerant from the system using a refrigerant recovery unit if the shut-off valves are to be removed with the compressor.
2. Remove the compressor.
3. Drain the oil from the compressor and close all open connections immediately.
4. Check the oil quantity and the degree of contamination (see p.17).



Oil return operation

Compressor oil mixed with refrigerant is circulating in the air conditioning system.
Perform the oil return operation to return this oil to the compressor before removing components from the system.

1. Open the doors and windows and operate the blower motor at maximum speed.
2. Operate the vehicle engine at idling during at least 20 minutes.

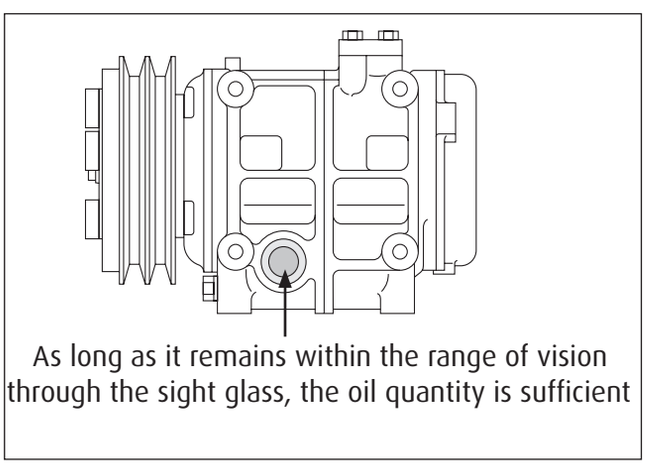
Note: The maximum amount of oil cannot be recovered at higher speeds. This operation also requires a warm ambient temperature.

Oil handling

Oil specification

Use only ZXL 100PG PAG (DH-PS).

Oil quantity inspection



As long as it remains within the range of vision through the sight glass, the oil quantity is sufficient

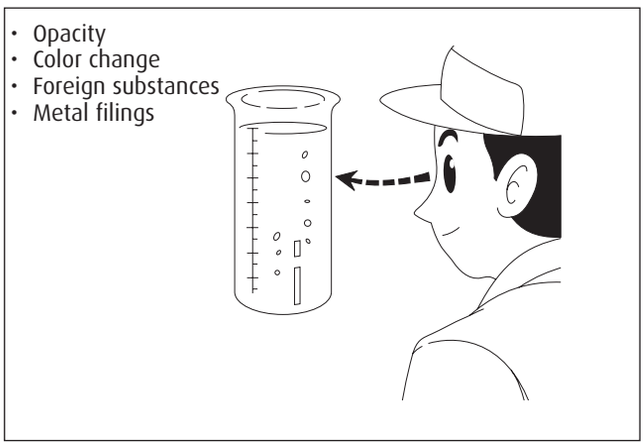
There is no particular need for frequent inspection or replacement, although it is recommended to check operating refrigerent pressures and oil levels at the start of the season.
Please replace the refrigerant and restore the system oil and refrigerant charge to factory specifications if:

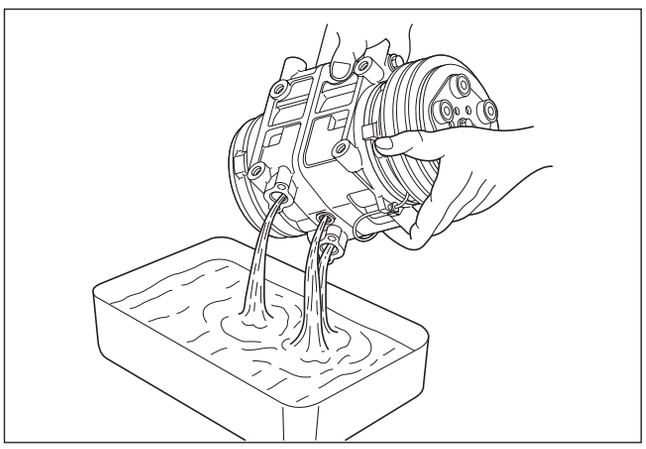
- the AC system is opened for repair or replacement of any component (e.g.: evaporator, condenser or receiver drier)
- any loss of charge - refrigerant or oil - is detected.

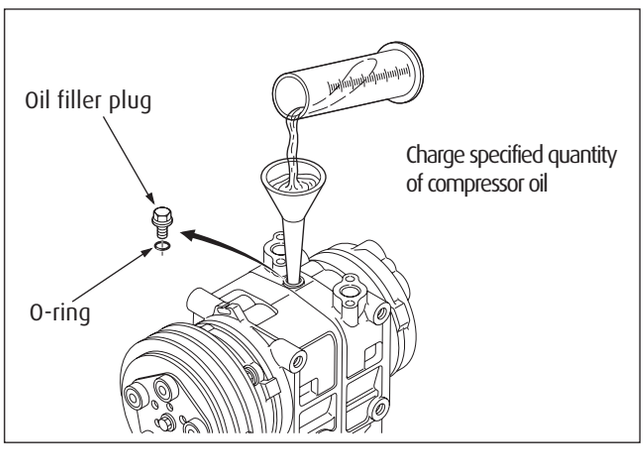
Oil level can be read through the sight glass of he compressor (see on the left).

Handling precautions

1. The oil must be free from dust, metal filings, etc.
2. Do not mix oils.
3. The moisture content must not exceed 1,000 ppm. (PAG oil only)
4. The oil easily absorbs moisture when the container is open. Therefore always seal the container immediately after use. (PAG oil only)







Oil contamination

Unlike engine oil, no cleaning agent is added to the compressor oil. Even if the compressor is run for a long period (approximately 1 season), the oil never becomes turbid as long as there is nothing wrong with the compressor or its method of use. Inspect the extracted oil for any of the following :

- Increased opacity of the oil.
- Color change to red.
- Presence of foreign matter, metal filings, etc.

WARNING!

When system (oil) contamination is found during compressor replacement, flush the A/C system with a fluid that meets SAE J2670 and replace the drier (or accumulator).

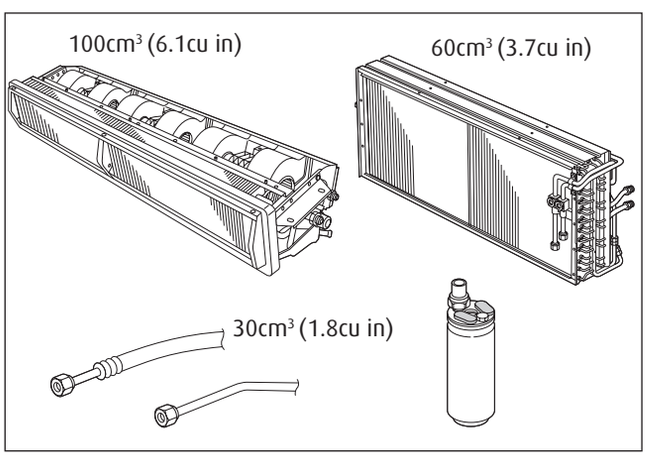
Oil check

The compressor oil must be checked as follows when being charged into a used system.

1. Perform the oil return operation (see p.16).
2. Remove the compressor from the vehicle.
3. Remove the oil filler plug and drain the oil through the oil filler plug and the high and low pressure connectors.
4. Check the oil for contamination.
5. Fill the compressor with the specified amount of oil through the oil filler plug (see p. 18).

unit: cm^3 & cc		Current Compressor is kept	Compressor is replaced
Specified charge	Amount recovered	Charging amount	Amount to remove from new compressor
500	350 or more →	Same as recovered	500-(amount recovered + 20)
	Under 350 →	350	130

unit: cu in		Current Compressor is kept	Compressor is replaced
Specified charge	Amount recovered	Charging amount	Amount to remove from new compressor
30.5	21.4 or more →	Same as recovered	30.5-(amount recovered + 1.2)
	Under 21.4 →	21.4	7.9



CAUTION!

The specified oil quantity differs, depending on the type of air conditioning system. A label describing the specified quantity is attached to the compressor. Additionally, all of the oil cannot be removed when draining the compressor, as some remains as an oil film on the inside of the compressor and the system components. Therefore, refer to the table at the left when recharging the compressor with oil. Excess oil adversely affects the cooling capacity and the compressor.

6. Install the oil filler plug and tighten it to the specified torque.
   Specified torque: 14 ~ 16 N·m {1.4 ~ 1.6 kgf·m, 10.3 ~ 11.8 lbf·ft}

CAUTION!

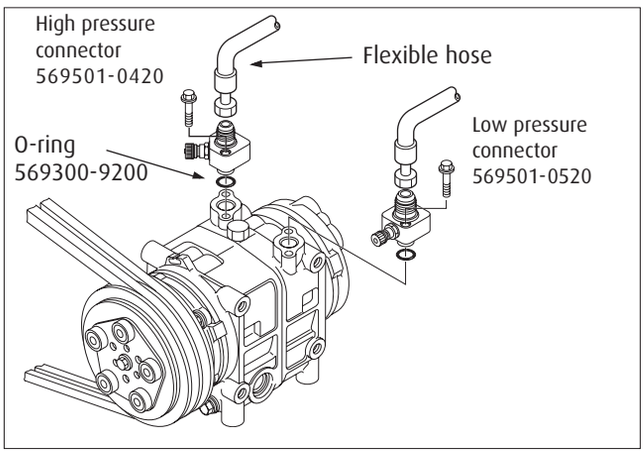
The oil filler plug O-ring must be replaced with a new one.

Replacement of components

When replacing the system's component parts, supply the following amount of oil to the compressor.

Component mounted	Amount of oil
Evaporator	100 cm^3 (6.1 cu in)
Condenser	60 cm^3 (3.7 cu in)
Receiver drier	30 cm^3 (1.8 cu in)
Pipe or hose	30 cm^3 (1.8 cu in)

After installing these component parts, check the compressor oil. (See p.16).



Running-in operation

Whenever moving parts have been replaced, it is necessary to run-in both the compressor and the magnetic clutch.

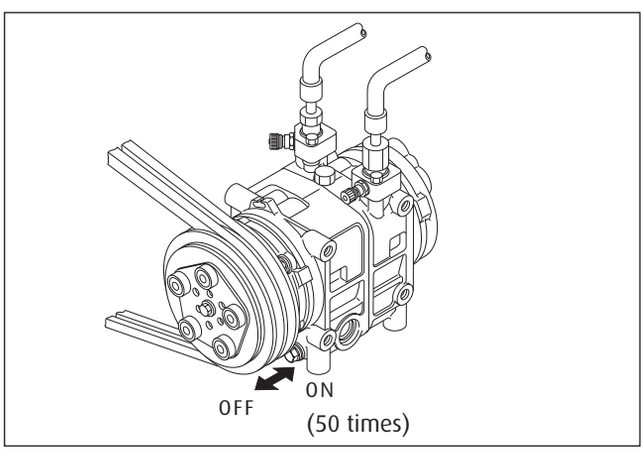
Compressor running-in

Reassembled compressors must be run-in after the leak test (see next page).

1. Check that the compressor contains the specified amount of oil.
2. Install the compressor on the test bench.
3. Install the high pressure connector (569501-0420) and the low pressure connector (569501-0520) to the ports and tighten the bolts to the specified torque.
   Specified torque: 20 ~ 24 N·m
   {2.0 ~ 2.4 kgf·m, 14 ~ 17 lbf·ft}
4. Connect the two connector ports using a flexible hose.
5. Run the compressor at 1,000 rpm for at least 30 minutes.
6. Replace the oil.
7. Repeat the leak test.

CAUTION!

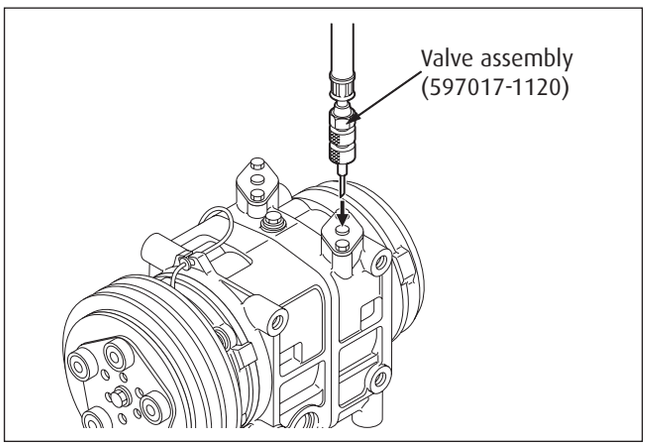
While the compressor is being run-in in step 5 above, check the outside temperature of the front head. If the temperature exceeds 80°C (176°F), stop the running-in operation. Resume the operation when the head has cooled.



Magnetic clutch running-in

1. Install the clutch on the compressor.
2. Install the compressor on the test bench, and operate the compressor by running the system.
3. Maintain the compressor speed at 500 rpm. Operate the A/C switch through the ON/OFF cycle at least 50 times (“ON” for 10 seconds and “OFF” for 10 seconds).

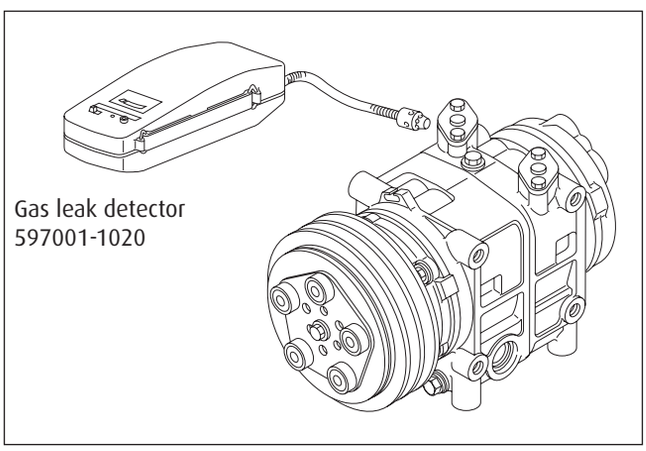
3- Handling instructions

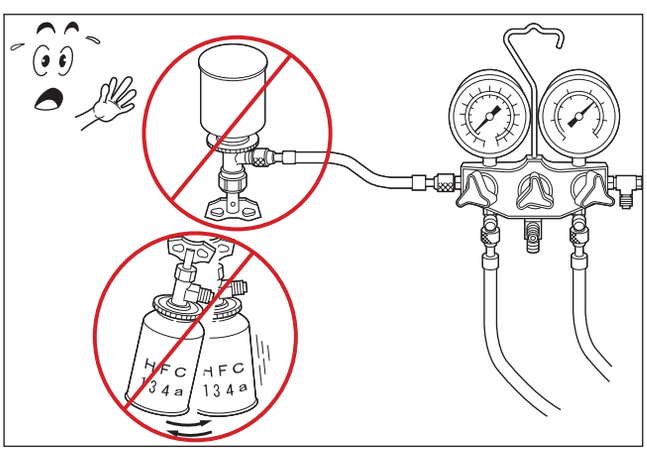


Leak test

The compressor must be checked for refrigerant leaks after it is repaired. The procedure is as follows.

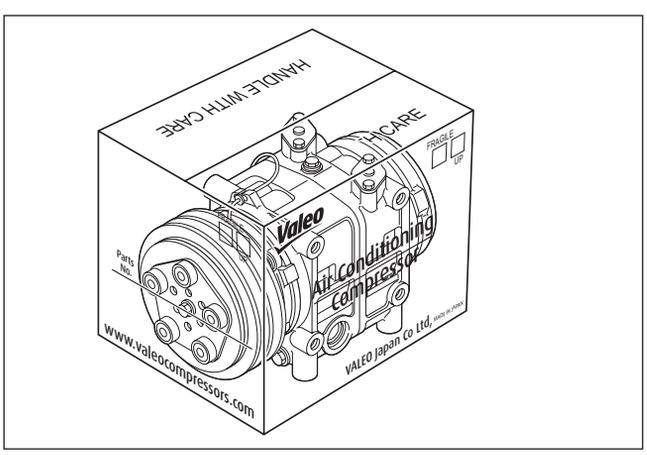
1. Fit plates to the suction and discharge connections, and tighten it to the specified torque.
   Specified torque: 20 ~ 24 N·m
   {2.0 ~ 2.4 kgf·m, 14 ~ 17 lbf·ft}
2. Using the valve assembly (597017-1120), fill the compressor with refrigerant through the suction side, raising the refrigerant pressure to at least 0.49 MPaG {5 kgf/cm^2, 71 psig}.
3. Check the compressor for leaks using a leak detector.





Refrigerant charging

In order to prevent a liquid charge and greatly increase risks of compressor dammage, do not shake or turn the refrigerant bottle upside-down.



Storing a repaired compressor

If it is necessary to store a repaired compressor for some time before installation, evacuate the compressor and fill it with dry nitrogen gas through the suction fitting to raise the pressure to **49~150kPa {0.5~1.5kgf/cm^2, 7.1~21psig}**.

4- Troubleshooting

Compressor troubleshooting

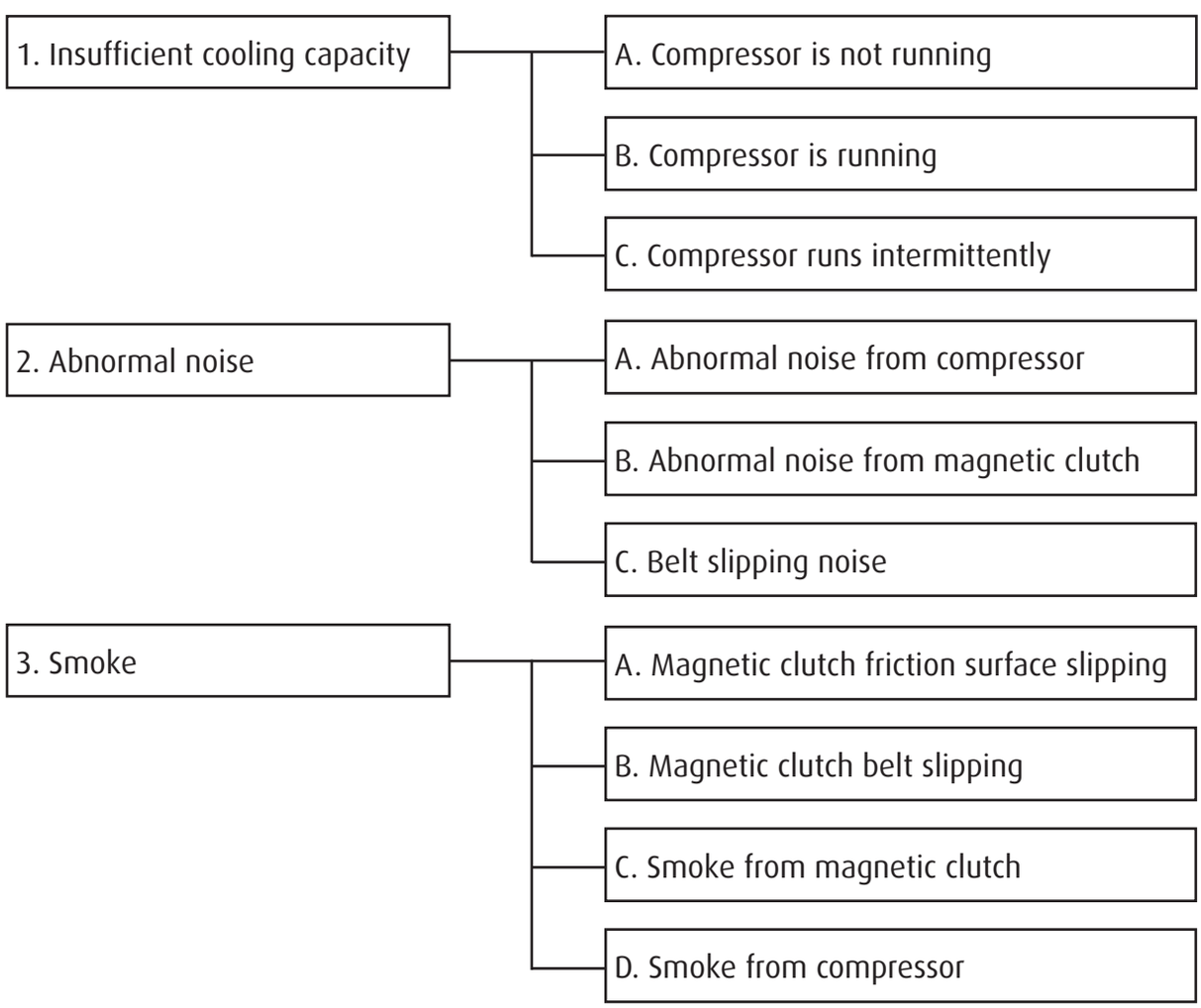
When a problem occurs during the compressor operation, it is often difficult to pinpoint exact the cause of the malfunction.
As long as the compressor maintenance is done correctly, there should not be any problem throughout the whole vehicle life, but should it happen, we hope this troubleshooting can help you solve the issue efficiently.

Below are listed most of the issues you may encounter while the A/C is ON.
Please refer to the compressor troubleshooting tree to localize the malfunction symptom, then look at the table (p.22 - 23) for the appropriate counter measure.

Most of the malfunction symptoms can be classified in the following categories:
1. Insufficient cooling capacity
2. Abnormal noise
3. Smoke

In case of insufficient cooling capacity, we recommend that you prepare a gauge manifold to measure the pressure of both discharge and suction sides (for a detailed diagnosis by gauge pressure, see p.24 - 25).

Compressor troubleshooting tree


1. Insufficient cooling capacity
A. Compressor is not running
B. Compressor is running
C. Compressor runs intermittently
2. Abnormal noise
A. Abnormal noise from compressor
B. Abnormal noise from magnetic clutch
C. Belt slipping noise
3. Smoke
A. Magnetic clutch friction surface slipping
B. Magnetic clutch belt slipping
C. Smoke from magnetic clutch
D. Smoke from compressor

1. Insufficient cooling capacity

	Issue	Symptom	Possible cause	Measure
A	Compressor is not running (No cool blow coming out)	Magnetic clutch slips when turning on the A/C switch	Compressor internal part damage	Replace the compressor
		Low pressure cut switch operate (see p.24 - 25)	Refrigerant shortage	Fix the refrigerant leakage then fill with refrigerant until reaching the right amount
		The magnetic clutch slips or does not engage when the compressor runs	Lead wire short circuit or wiring connector not seated properly	Replace the lead wire if it is defective
			Magnetic clutch damage	Repair or replace the magnetic clutch
			Magnetic clutch air gap too wide	Adjust air gap or replace magnetic clutch
			Low magnetic clutch voltage	Charge battery
		The magnetic clutch engages but the armature does not rotate	Belt slipping	Replace the compressor if it is locked
		Belt run off the pulley	Compressor internal part damage or magnetic clutch damage	Replace the compressor or the magnetic clutch
		Center bolt is loose / Center bolt is missing	Bolt drop off/ Armature drop off	Replace magnetic clutch
B	Compressor is running (No cool blow coming out)	Compressor is running normally	Poor compression	Replace the compressor
		No difference of temperature between discharge side and suction side (see p.24 - 25)	Refrigerant shortage	Fix the refrigerant leakage then fill with refrigerant until reaching the right amount
		The magnetic clutch slips or does not engage when the compressor is running	Magnetic clutch friction surface slipping	Charge the battery or replace the magnetic clutch
			Loose connection of the magnetic clutch electrical circuit	Replace the magnetic clutch after making sure it is defective
		Belt slipping	Magnetic clutch belt slipping	Belt tension readjustment
		The magnetic clutch does not engage	Defective sensor	Replace the sensor after making sure it is defective
C	Compressor runs intermittently (Cool blow comes out only from time to time)	Both discharge and suction pressures are high	Excess of refrigerant	Reduce the refrigerant charge until reaching the right amount
			Condenser fan failure	Replace the condenser after making sure it is defective
		The magnetic clutch slips or does not engage when the compressor is running	Loose connection of the magnetic clutch electrical circuit	Replace the magnetic clutch after making sure it is defective
		The magnetic clutch does not engage	Defective sensor	Replace the sensor after making sure it is defective

2. Abnormal noise

	Issue	Symptom	Possible cause	Measure
A	Abnormal noise from the compressor	Abnormal vibration after turning on the A/C switch	Compressor installation bolt is loose	Increase tightening torque of the loose bolts
			Wide gap at the attaching portion between the compressor and the bracket	Improve the compressor attaching portion
		Abnormal noise from the compressor body	Compressor body internal component damage	Replace the compressor
B	Abnormal noise from the magnetic clutch	The magnetic clutch has a backlash and slips	Magnetic clutch damage	Replace the magnetic clutch
		Strange noise when the magnetic clutch engages	Air gap too wide	Adjust air gap or replace magnetic clutch
		Armature slips / does not engage when the compressor is running	Magnetic clutch friction, slippery surface	Charge battery or replace magnetic clutch
C	Belt slipping noise	Armature does not rotate when magnetic clutch engages	Belt slipping	Replace the compressor if locked. Readjust the belt tension if the belt is loose

3. Smoke

	Issue	Symptom	Possible cause	Measure
A	Magnetic clutch friction surface slipping	The magnetic clutch slips / does not engage when the compressor is running	Magnetic clutch air gap too wide	Adjust air gap or replace magnetic clutch
			Low magnetic clutch voltage	Charge battery
			Magnetic clutch friction, greasy surface	Clean friction surface or replace magnetic clutch
B	Magnetic clutch belt slipping	The magnetic clutch slips / does not engage when the compressor is running	Belt alignment is not correct	Adjust the compressor installation position
			Magnetic clutch belt is greasy	Clean or replace the belt
			Magnetic clutch belt tension is loose	Adjust belt tension
C	Smoke from the magnetic clutch	The magnetic clutch does not engage	Coil open or shorted	Replace the magnetic clutch
D	Smoke from the compressor	Refrigerant / oil is blowing out	Refrigerant leaking, uncoupled piping or piping burst	Fix the refrigerant leakage then fill with refrigerant until having the right amount

A/C cycle diagnosis by gauge pressure

Following is a diagnosis procedure to connect gauge manifold to A/C cycle, measure suction and discharge pressures and analyze the defects of the cycle.

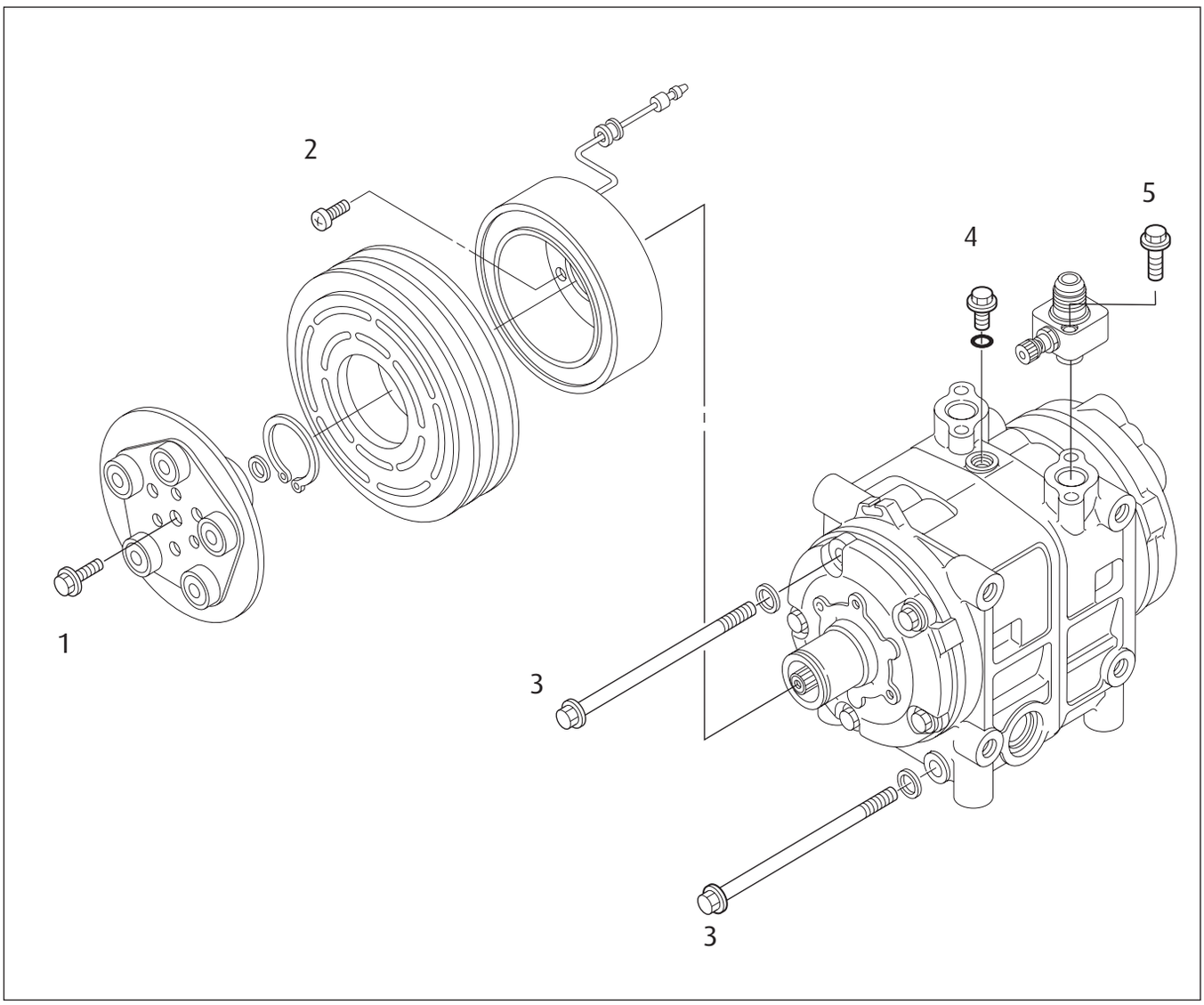
Operation conditions of the A/C cycle for pressure measuring:
1. Ambient temperature: 30 - 35 °C
2. Engine speed: 1,500 rpm
3. A/C switch: ON
4. Blower speed: high
5. Temperature control: full cold

Gauge pressure indication	Cause	Confirmation method	Action to take
Pressure is normal	A/C cycle operates normally. If there is any defect (poor cooling performance), there must be another cause Discharge pressure: around 1.0 - 1.7 MPaG (10 - 17 kgf/cm²) Suction pressure: around 0.13 - 0.20 MPaG (1.3 - 2.0 kgf/cm²)		
Both discharge and suction pressures are low Suction pressure becomes vacuum	Refrigerant shortage	Connect gauge manifold to cycle	Recover refrigerant, then refill with the right amount of refrigerant
	Receiver dryer is clogged	Temperature difference between inlet and outlet pipes. Dryer is covered with frost	Replace parts
	Expansion valve is clogged	Expansion valve was covered with frost	Clean or replace part
	Enclosure leakage from Expansion valve's temperature sensing tube. (Expansion valve operates to close the valve opening)	Outlet side of Expansion valve is not cooling. (Low side of gauge indicates vacuum)	Replace part
	Temperature sensing device at outlet air is defective	Evaporator becomes frozen up	Adjust or replace the part
	Refrigerant piping is clogged or crashed	If any part between the dryer and the compressor is clogged or crashed, the low side pressure becomes vacuum	Adjust or replace the part

4- Troubleshooting

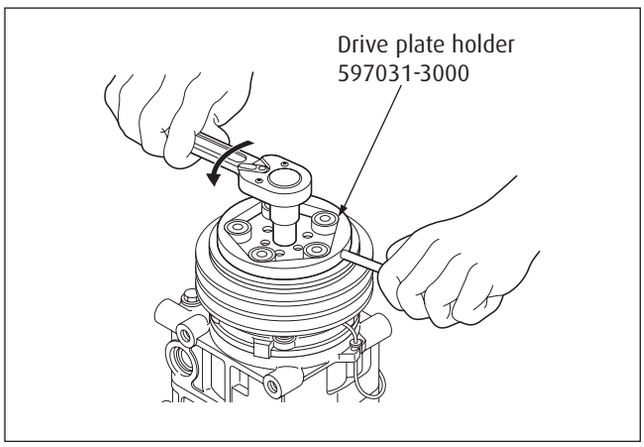
Gauge pressure indication	Cause	Confirmation method	Action to take
Both discharge and suction pressures are high	Excess of refrigerant	Connect gauge manifold to cycle	Recover refrigerant, then refill with the right amount of refrigerant
	Condenser cooling malfunction	Condenser becomes muddy and fins are clogged and collapsed. Defect of cooling fan rotation. Malfunction of fan motor for condenser.	Clean up, hand repair of fin and replacement
	Misaligned Expansion valve or thermal sensing tube of the Expansion valve is not fit on regularly. (Excess opening of Expansion valve)	Defective refrigerant flow control, the thermal sensing tube is not closely in contact with the evaporator pipe	Adjustment or replacement
	Air mixed in refrigeration cycle	Just after compressor stops, discharge pressure will come down immediately to 0.29 - 0.39 MPaG (3 - 4 kgf/cm^2)	Evacuate air from cycle, the charge with the adequate amount of refrigerant
Discharge pressure is high and suction pressure is low	Refrigerant cycle is clogged between compressor and condenser	Appreciable temperature difference at the clogged location	Clean up inside the cycle or replace the part
Discharge pressure is low and suction pressure is high	Defect of the compressor valve or gasket	Discharge and suction pressures balance immediately after the compressor stops. (Defective compression of compressor)	Replace the compressor

5- Tightening torques



Unit : N·m {kgf·m, lbf·ft.}

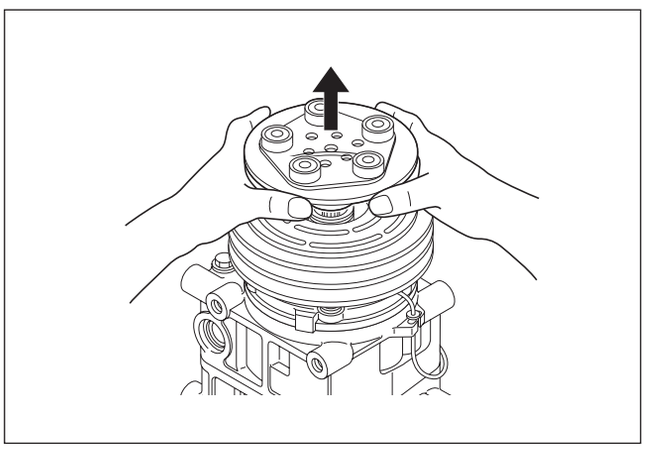
Part	Thread size	Tightening torque
1. Center bolt	M8 x 1.25	**20 - 22** {2.0 - 2.2, 14 - 16}
2. Field coil	M6 x 1.0	**8.0 - 10.0** {0.8 - 1.0, 6 - 7}
3. Bolt	M10 x 1.5	**25 - 30**{2.5 - 3.0, 18 - 22}
4. Oil filler plug	M10 x 1.5	**14 - 16** {1.4 - 1.6, 10 - 12}
5. Connector bolt	M8 x 1.25	**20 - 24** {2.0 - 2.4, 14 - 17} for connectors



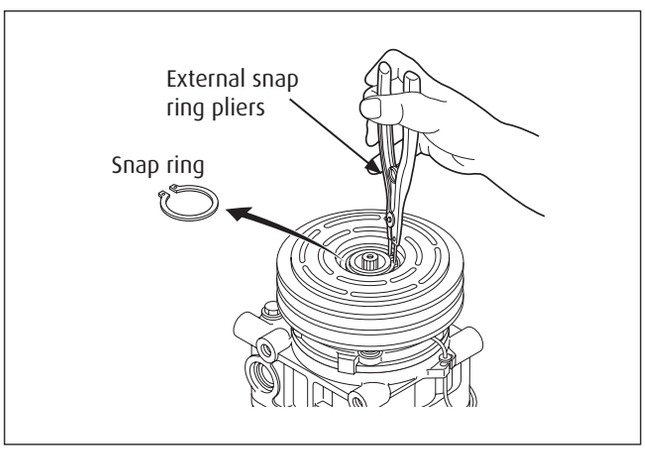
Magnetic clutch

Removal

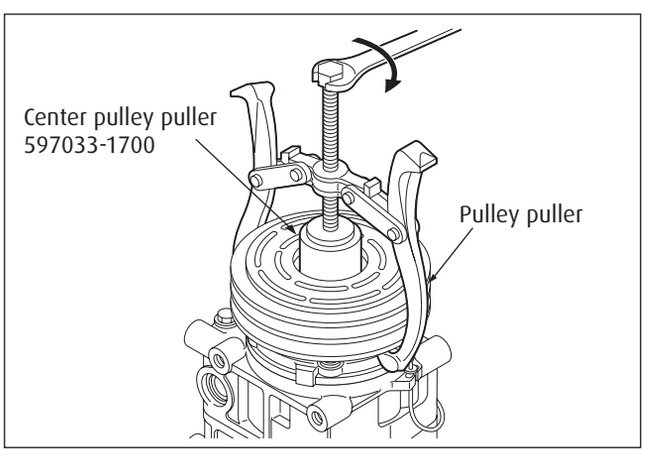
1. Remove the center bolt using the drive plate holder (597031-3000) to prevent the armature assembly from rotating.



2. Remove the armature assembly.



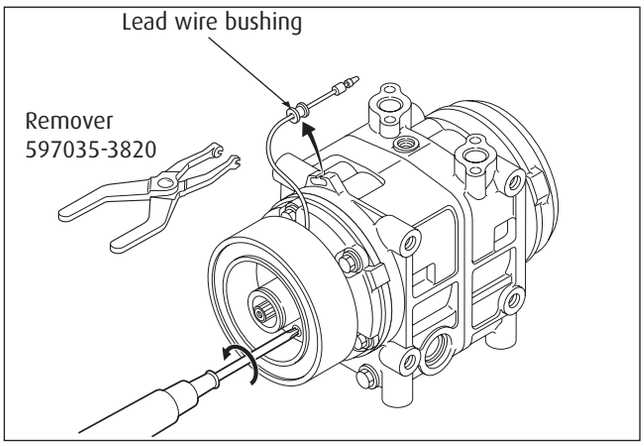
3. Remove the snap ring using external snap ring pliers.



4. Position the center pulley puller (597033-1200) at the end of the driveshaft.
5. Attach a suitable pulley puller to the pulley. Hook the puller claws to the edge of the pulley as shown.
6. Tighten the center pulley puller bolt to remove the pulley.

CAUTION!

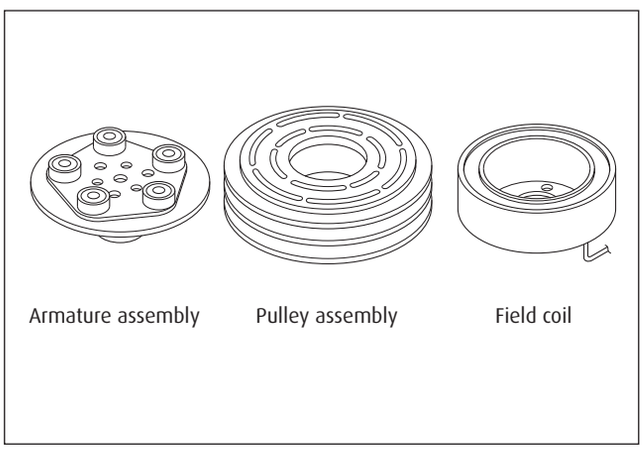
Do not clip the puller claws into the pulley groove to prevent pulley groove damage.



5. Remove the lead wire bushing of the field coil using the remover (597035-3820).
6. Remove the three field coil/compressor screws. Then remove the field coil.

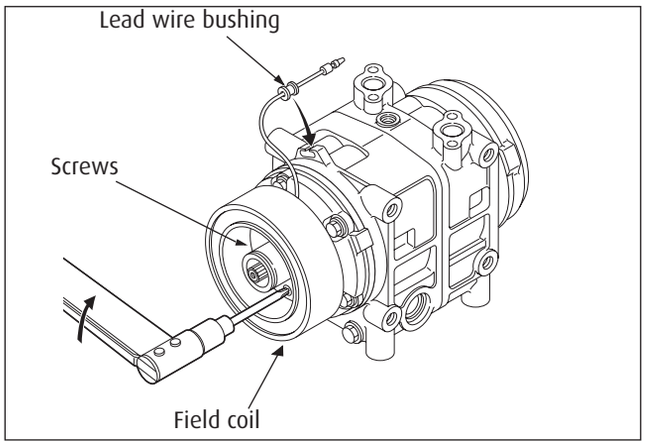
CAUTION!

Do not hold the field coil by the harness.



Inspection

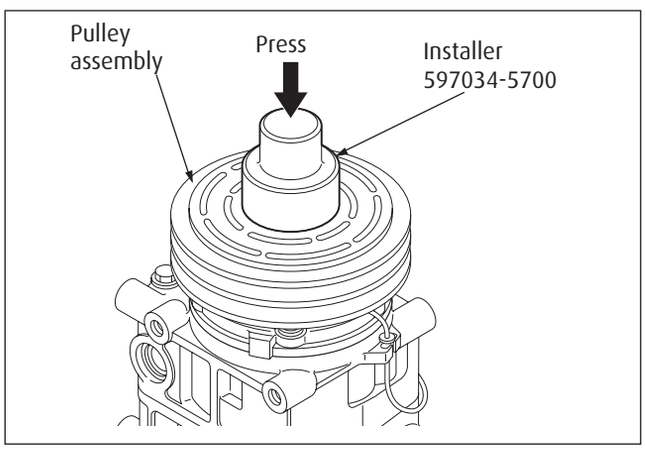
1. If the contact surface has been damaged by excessive heat, the armature and pulley must be replaced.
2. Check the appearance of the pulley assembly. If the contact surface of the pulley is excessively grooved due to slippage, both the pulley and the armature must be replaced. The contact surface of the pulley assembly must be cleaned with a suitable solvent before reinstallation.
3. Check the field coil for a loose connector or cracked insulation.



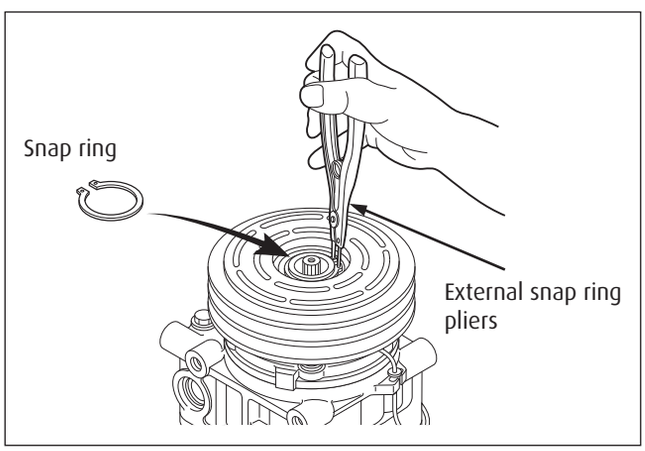
Magnetic clutch

Installation

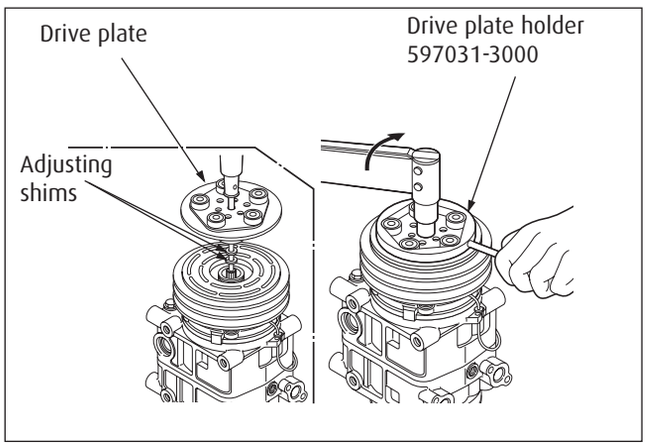
1. Install the field coil on the compressor (with the harness on top) and tighten the mounting screws to the specified torque.
   Specified torque: 8.0 ~ 10 N·m
   {0.8 ~ 1.0 kgf·m, 6.0 ~ 7.0 lbf·ft}

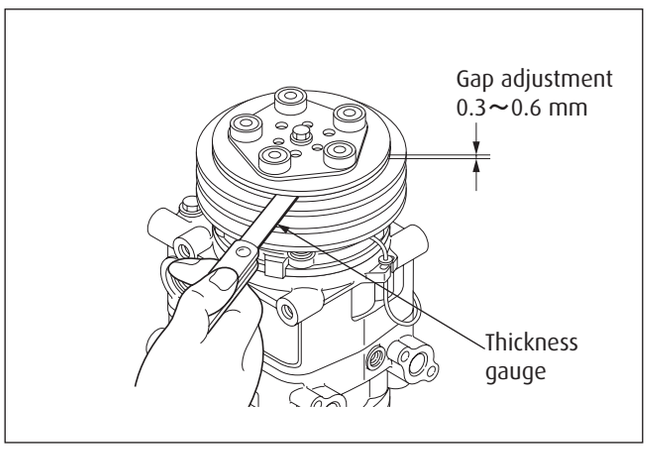


2. Carefully place the wire harness bushing.
3. Install the pulley assembly using the pulley installer (597034-5700) and a hand press.



4. Install the snap ring (beveled edge up) using external snap ring pliers.





5. Install the armature assembly on the driveshaft together with the original shim(s). Press the armature assembly down by hand.
6. Install the center bolt and tighten to the specified torque using the drive plate holder (597031-3000) to prevent the armature assembly from the rotating.
   Specified torque: 20 ~ 22 N·m
   {2.0 ~ 2.2 kgf·m, 14 ~ 16 lbf·ft}

CAUTION!

After tightening the center bolt, check that the pulley rotates smoothly.

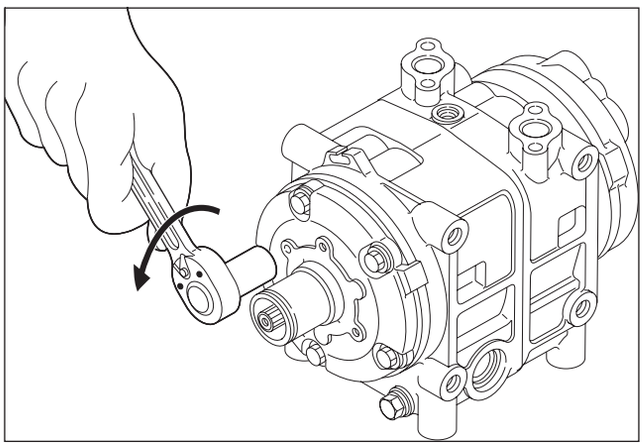
7. Check that the clutch clearance is as specified. If necessary adjust the clearance using shim(s).

Adjusting shims are available in the following thickness :

Shim Part No.	Thickness
596541-2600	0.1 mm (0.004 in)
596541-2700	0.3 mm (0.012 in)
596541-2800	0.5 mm (0.020 in)
596541-2900	0.8 mm (0.031 in)

Specified clearance: 0.3 ~ 0.6 mm
{0.01 ~ 0.02 in}

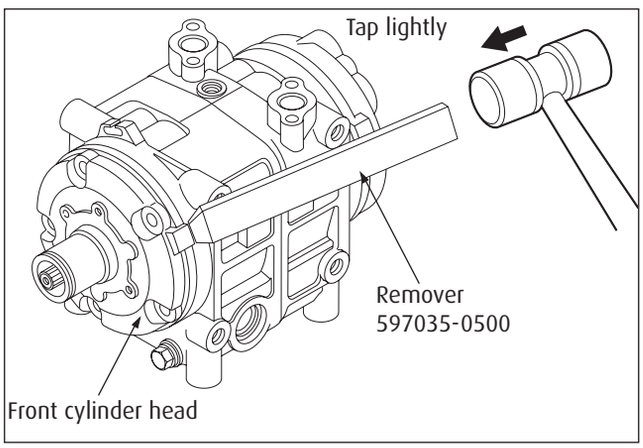
8. Run-in the clutch as described on page 19.



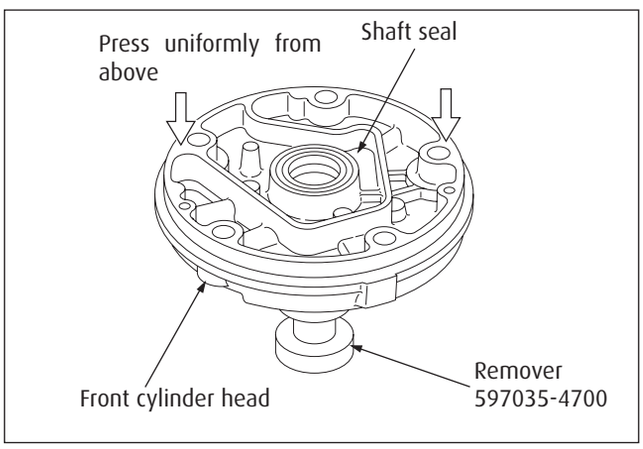
Shaft seal assembly

Removal

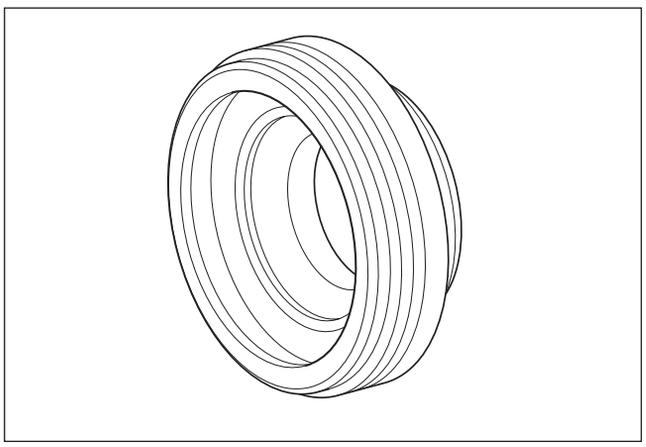
1. Remove the magnetic clutch assembly as described on page 27.
2. Remove the four bolts securing the connectors, and then remove the connectors and strainer from the cylinder shaft assembly.
3. Remove the oil filler plug and then drain the oil.
4. Remove the five bolts securing the heads.



5. Alternately tap the two projections on the front head using the remover (597035-0500) and a mallet to remove the front cylinder head.

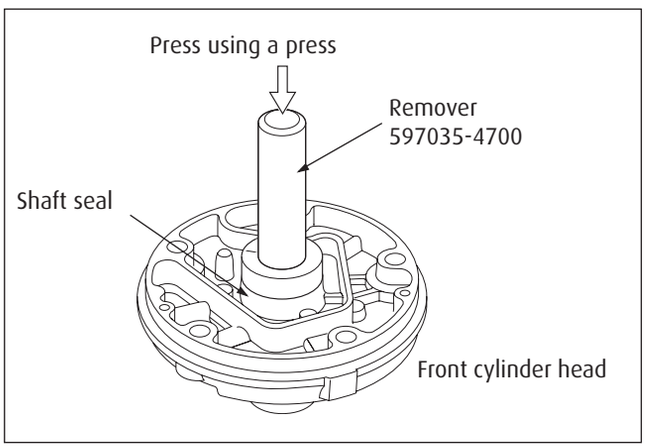


6. Remove the shaft seal assembly using the remover (597035-4700).



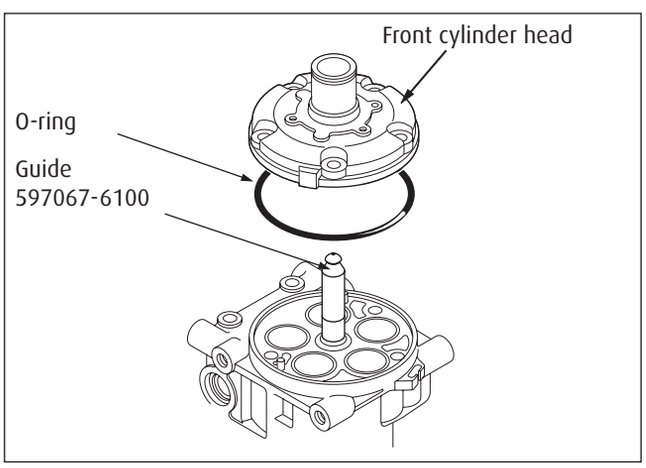
Inspection

The shaft seal must not be reused.
Always use a new shaft seal when reassembling the compressor. Ensure that the seal seat is free from lint and dirt that could damage the shaft seal lip.



Installation

1. Clean the portion of the front cylinder head where the shaft seal is to be assembled.
2. Assemble the shaft seal on the remover (597035-4700).
3. Coat the shaft seal well with compressor oil and install the shaft seal in the front cylinder head.
4. Remove the shaft seal remover.

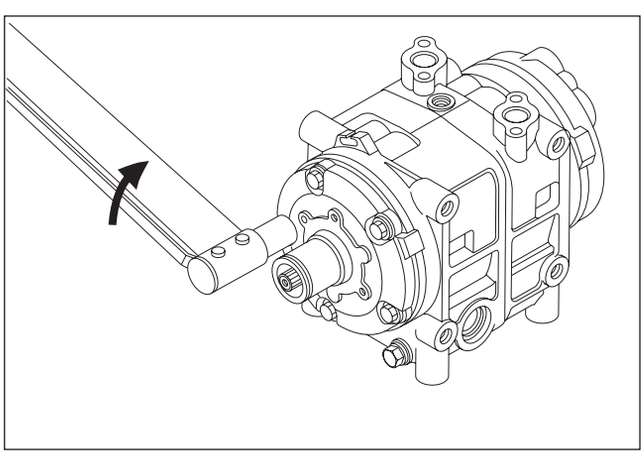


5. Position the guide (597067-6100) on the shaft.
6. Coat the new O-ring with clean compressor oil and install it in the front cylinder head.
7. Install the front cylinder head.

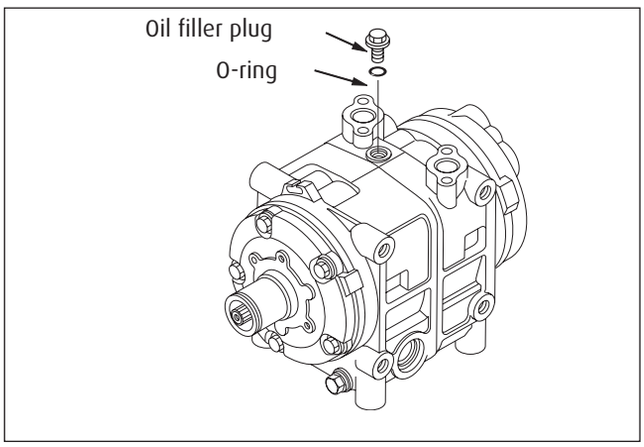
CAUTION!

Align the roll pins and tap the head lightly and evenly with a plastic hammer.

8. Remove the guide (597067-6100).



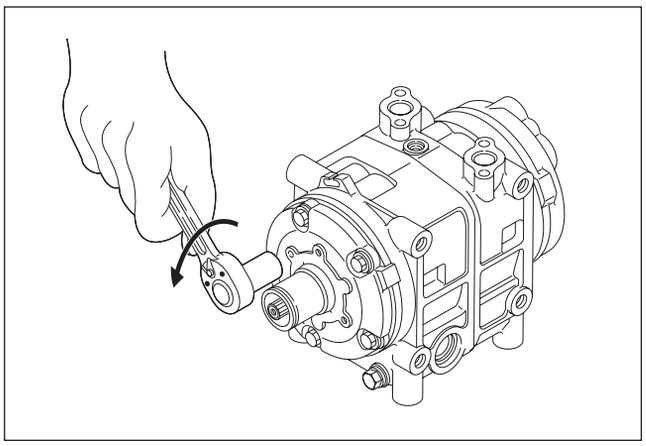
9. Install the five bolts from the front cylinder head side and tighten them to the specified torque.
   Specified torque: 25 ~ 30 N·m
   {2.5 ~ 3.0 kgf·m, 18 ~ 22 lbf·ft}
   Tighten each bolt gradually (in three or more stages) to ensure the specified torque.
10. Turn the drive shaft 2 ~ 3 times by hand to ensure that the shaft rotates smoothly.



11. Fill the compressor with the specified amount of clean compressor oil through the oil filler.
12. Install the oil filler plug with a new O-ring, and tighten it to the specified torque.
    Specified torque: 14 ~ 16 N·m
    {1.4 ~ 1.6 kgf·m, 10 ~ 12 lbf·ft}
13. Install the strainer in the suction port.

When the connectors are installed

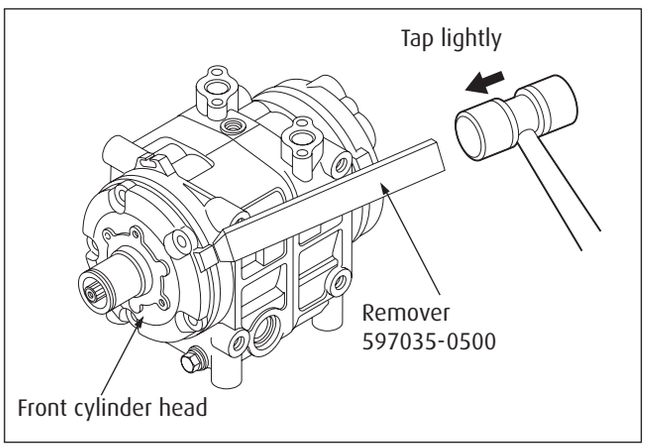
14. Fit plates to the suction and discharge connections, and tighten them to the specified torque.
    Specified torque: 20 ~ 24 N·m
    {2.0 ~ 2.4 kgf·m, 14 ~ 17 lbf·ft}
15. Install the magnetic clutch as described on page 29.
16. Run-in the compressor as described on page 19.
17. Perform the leak test as described on page 20.



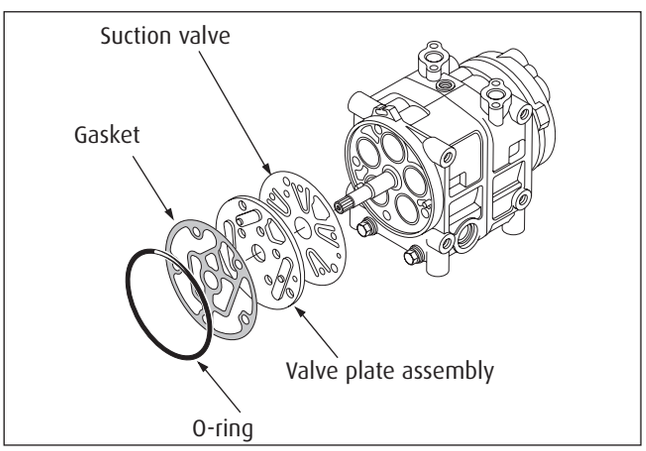
Cylinder heads (Front & Rear)

Disassembly

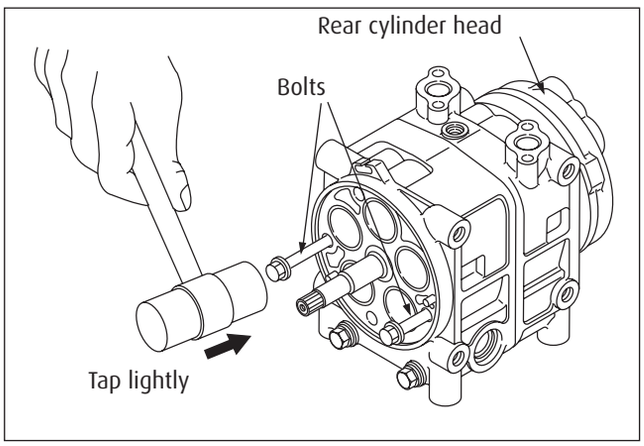
1. Remove the magnetic clutch assembly as described on page 27.
2. Remove the four bolts securing the connectors, and then remove the connectors and strainer from the cylinder shaft assembly.
3. Remove the oil filler plug and then drain the oil.
4. Remove the five bolts securing the heads.



5. Alternately tap the two projections on the front head using the remover (597035-0500) and a mallet to remove the front cylinder head.



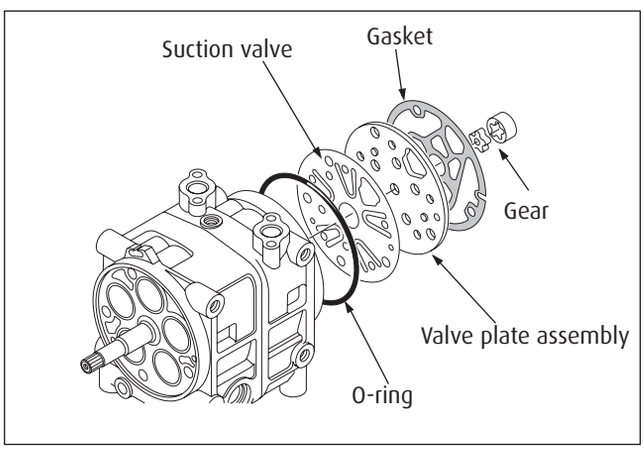
6. Remove the front valve plate assembly and then the suction valve (in that order).
7. Remove and discard the O-ring from the front cylinder head.
8. Remove all gasket material from the front cylinder head and the front valve plate.



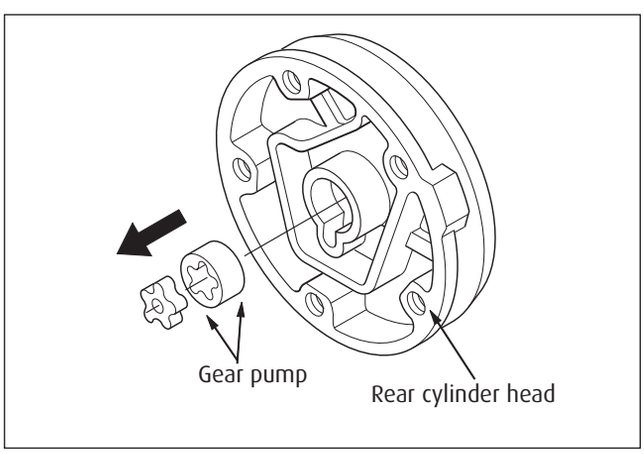
9. Screw two bolts into the opposite sides of the rear cylinder head and tap alternate bolts lightly with a plastic hammer to remove the head.

CAUTION!

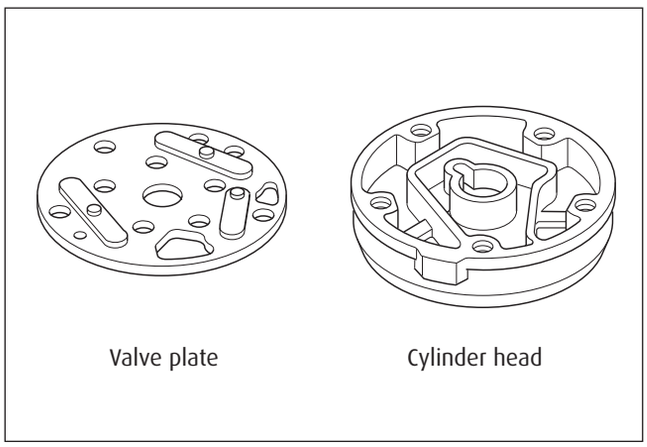
Screw the bolts fully into the head to prevent rear head thread damage.



10. Remove the rear valve plate assembly and then the suction valve (in that order).
11. Remove and discard the O-ring from the rear cylinder head.
12. Remove all gasket material from the rear cylinder head and the rear valve plate.



13. Remove the gear pump from the rear cylinder head or the end of the driveshaft.

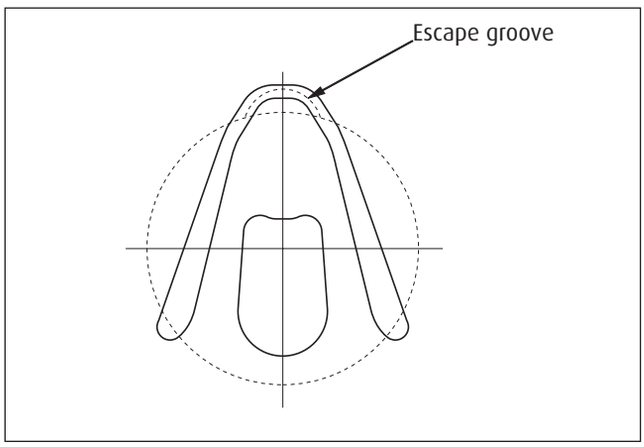


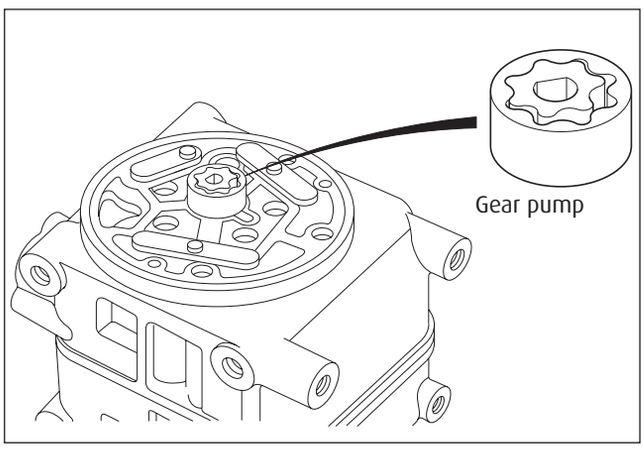
Valve plate

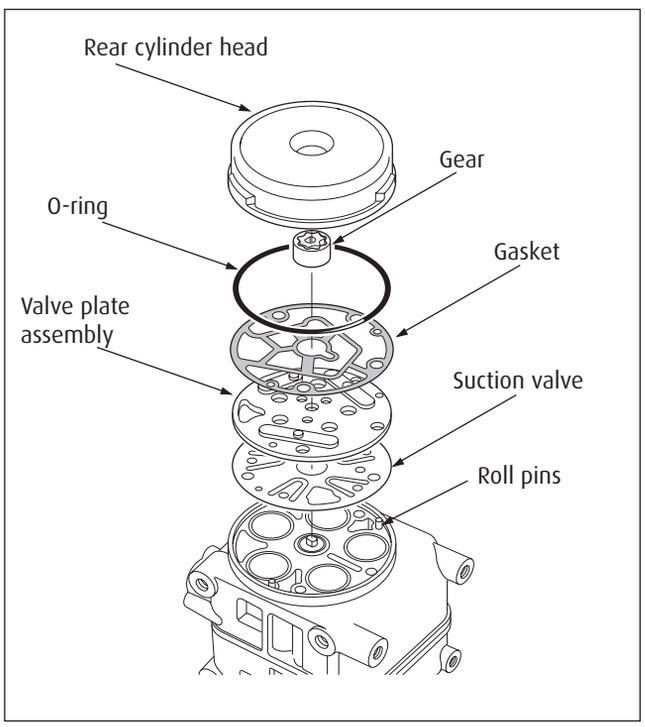
Cylinder head

Inspection

Check the front and rear valve plates for scratched, bent or damaged parts.
Inspect both cylinder heads and both valve plates for nicks or burrs on the sealing surfaces.
Clean both cylinder heads and both valve plates or replace them if they are cracked or damaged.
Check that none of the passages in the valve plates are blocked.







Reassembly

Rear cylinder head

1. Place the cylinder shaft assembly on the bench with the rear side up.
2. Install the rear suction valve so that it matches the roll pins.

CAUTION!

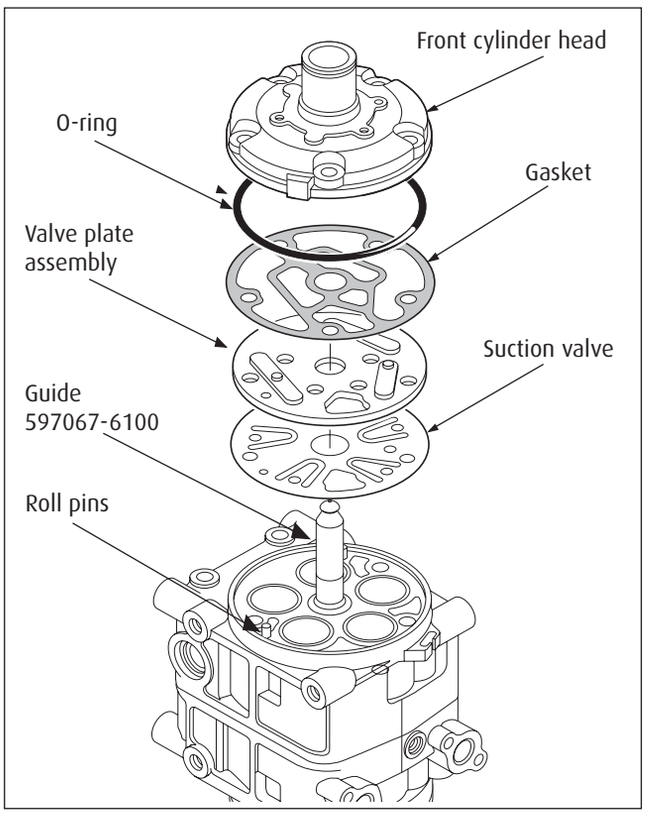
Ensure each valve matches each cylinder valve escape groove.

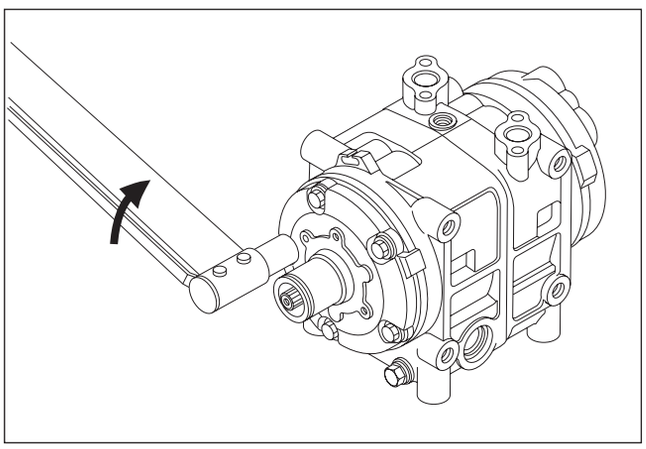
3. Install the rear valve plate on the rear suction valve.

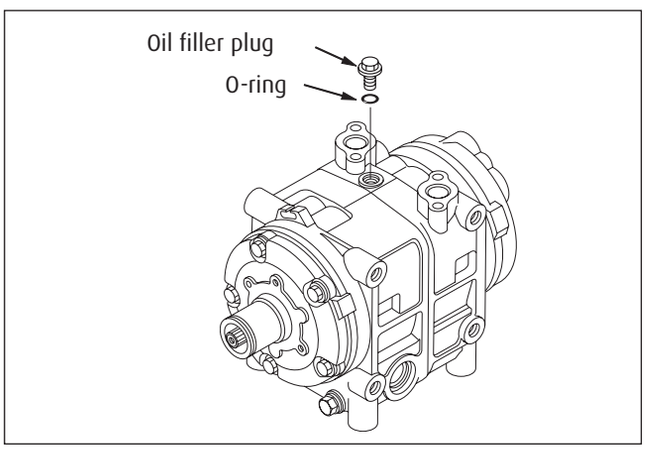
CAUTION!

Do not mistake the front and rear valve plates.

4. Coat the new gasket with clean compressor oil and install it on the rear valve plate.
5. Coat the new gear pump with clean compressor oil and install it on the end of the drive shaft.
6. Coat the new O-ring with clean compressor oil and install it on the rear cylinder head.
7. Install the rear cylinder head.
   When positioning the head, ensure the gear pump is inserted into the hole in the cylinder head.







Front cylinder head

1. Place the cylinder shaft assembly on the bench with the front side up.
2. Install the front suction valve so that it matches the spring pins.

CAUTION!

Ensure each valve matches each cylinder's valve escape groove.

3. Install the front valve plate on the front suction valve.
4. Coat the new gasket with clean compressor oil and install it on the front valve plate.
5. Position the guide (597067-6100) on the shaft.
6. Coat the new O-ring with clean compressor oil and install it on the front cylinder head.
7. Install the front cylinder head.

CAUTION!

Align the roll pins and tap the head lightly and evenly with a plastic hammer.

8. Remove the guide (597067-6100).
9. Install the five bolts from the front cylinder head side and tighten them to the specified torque.
   Specified torque: 25 ~ 29 N·m
   {2.5 ~ 3.0 kgf·m, 18 ~ 22 lbf·ft}
   Tighten each bolt gradually (in three or more stages) to ensure the specified torque.
10. Turn the drive shaft 2 ~ 3 times by hand to ensure that the shaft rotates smoothly.
11. Fill the compressor with the specified amount of clean compressor oil through the oil filler.
12. Install the oil filler plug with a new O-ring, and tighten it to the specified torque.
    Specified torque: 14 ~ 16 N·m
    {1.4 ~ 1.6 kgf·m, 10 ~ 12 lbf·ft}
13. Install the strainer in the suction port.

When the connectors are installed

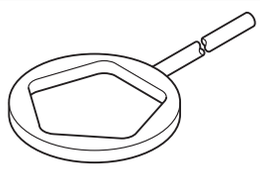
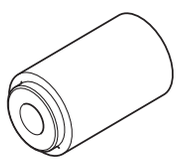
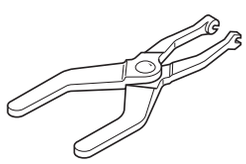
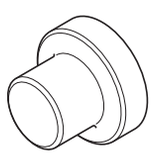
14. Fit blanking plates to the suction and discharge connections, and tighten it to the specified torque.
    Specified torque: 20 ~ 24 N·m
    {2.0 ~ 2.4 kgf·m, 14 ~ 17 lbf·ft}
15. Install the magnetic clutch (see p. 29).
16. Run-in the compressor (see p.19).
17. Perform the leak test (see p. 20).

9- Service tools

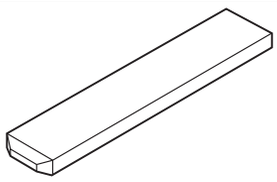
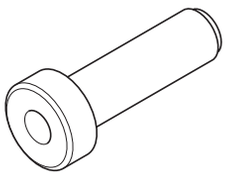
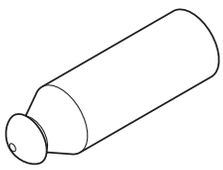
In addition to standard tools, numerous special tools are necessary to service the Valeo **TM31** compressor. The use of these special tools enables prompt and correct compressor service.

The special tools are classified into three groups: those for magnetic clutch disassembly and reassembly; those for compressor disassembly and reassembly; and those for testing and running-in operation.

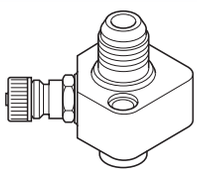
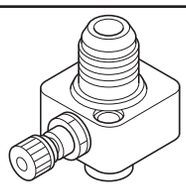
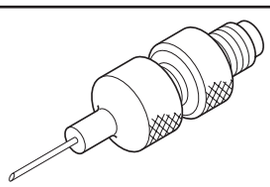
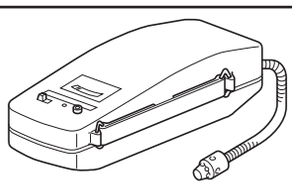
MAGNETIC CLUTCH TOOLS

Part name	Part No.	Shape	Reference page	Application
Drive plate holder	597031-3000		27 31	For fixing drive plate
Center pulley puller	597033-1700		27	For removing pulley
Remover	597035-3820		28	For removing lead wire bushing
Installer	597034-5700		30	For installing pulley

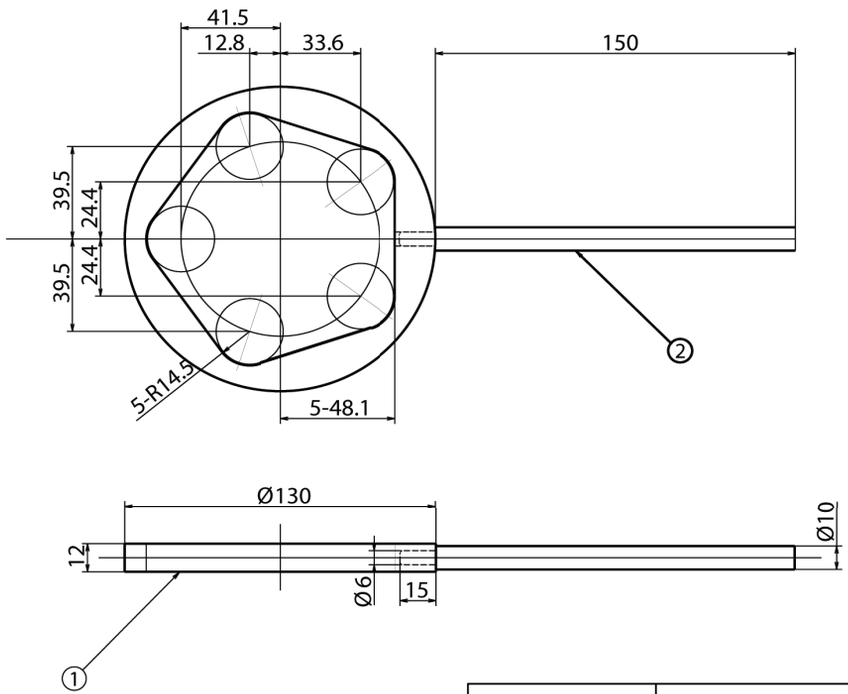
Compressor tools

Part name	Part No.	Shape	Reference page	Application
Remover	597035-0500		32 35	For removing cylinder head and cylinder block
Remover	597035-4700		32 33	For removing and installing shaft seal
Guide	597067-6100		33 39	For installing shaft seal

Test and inspection tools

Part name	Part No.	Shape	Reference page	Application
Connector	569501-0420		19	For high pressure port
Connector	569501-0520		19	For low pressure port
O-ring	569300-9200		19	For maintaining connector air tightness
Valve assembly	597017-1120		20	For charging refrigerant
Gas leak detector	597001-1020		20	For detecting gas leaks

Unit : mm



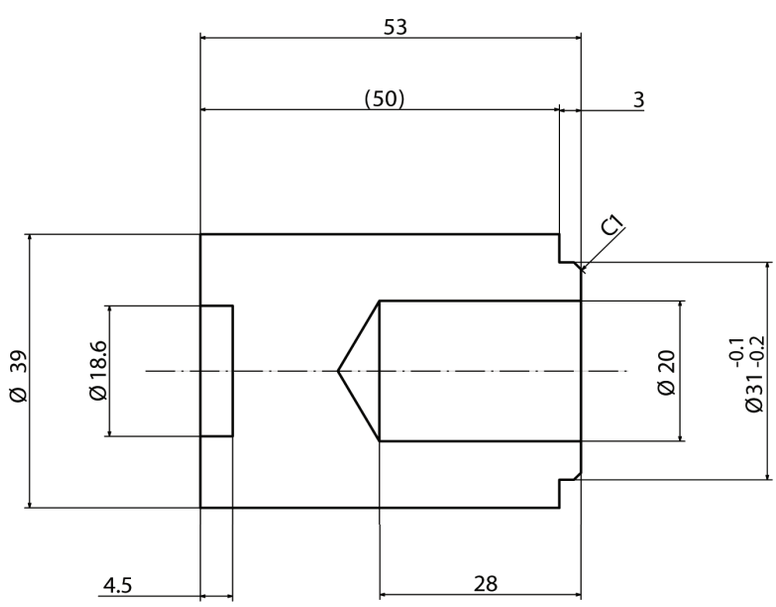
Unless otherwise specified,
the edges are slightly chamfered
to avoid burrs and fluff.

3rd Angle Proj.	Surface Treatment	
	Heat treatment & Hardness	--HQ HRC40-45
	Material	① S45C ② SS41B-D

Part Name

Drive plate holder

Unit : mm



Unless otherwise specified,
the edges are slightly chamfered
to avoid burrs and fluff.

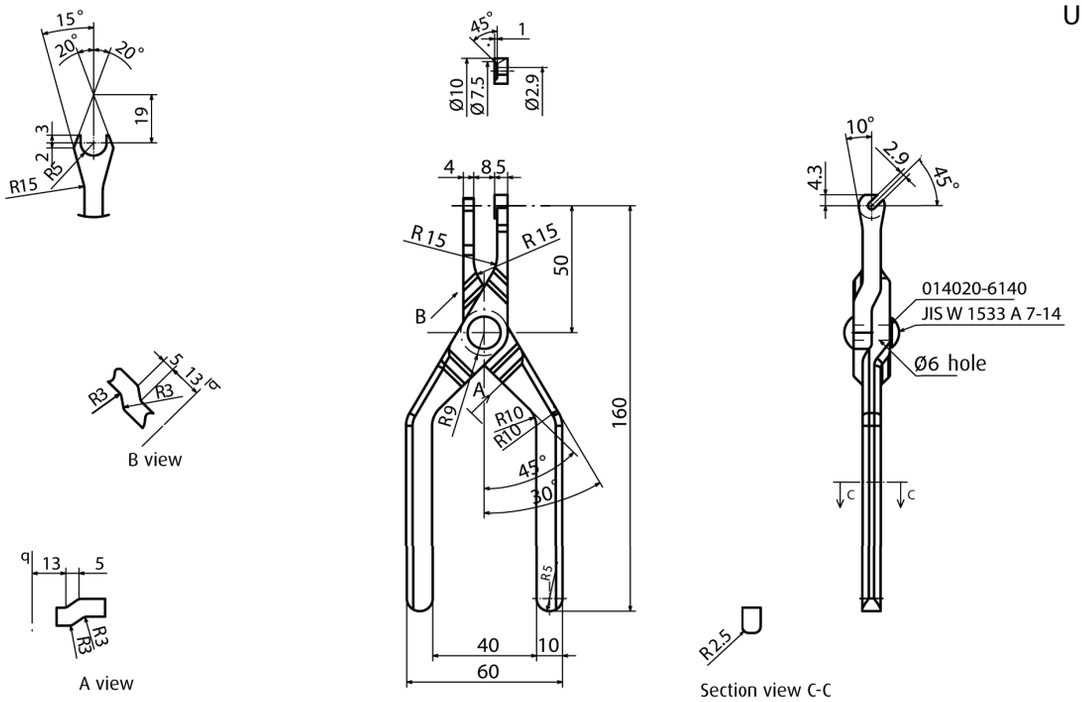
3rd Angle Proj.	Surface Treatment	
	Heat treatment & Hardness	---HQ-HTL HRC 40 to 45
	Material	S45C

Part Name

Center Pulley Puller

9 - Service tools

Unit : mm



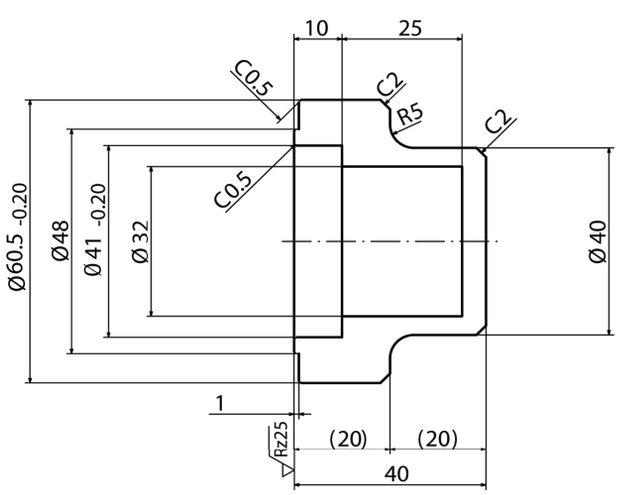
3rd Angle Proj.	Surface Treatment	MFZn8TC
	Heat treatment & Hardness	
	Material	SK5

Part Name

Remover Bush

Unless otherwise specified,
the edges are slightly chamfered
to avoid burrs and fluff.

Unit : mm



3rd Angle Proj.	Surface Treatment	
	Heat treatment & Hardness	HQ-HTL HRC 58
	Material	S45C

Part Name

Installer Pulley

Unless otherwise specified,
the edges are slightly chamfered
to avoid burrs and fluff.

10- Service parts

1. Compressor body service kits, sets and parts

Item*	Part name	Reference	Quantity
OVERHAUL KIT (O-RING SET + GASKET SET + SHAFT SEAL)		5699306221	-
O-RING SET		569920-4420	-
15,20	O-ring body (front & rear head)	569300-8900	n=2
18	O-ring drain	569300-4000	n=1
GASKET SET		569941-1921	-
12	Gasket front head	569310-6000	n=1
23	Gasket rear head	569310-6100	n=1
9	Gasket (bolt) 7 per set	569310-6200	n=7
SHAFT SEAL (for service)		-	-
11	Shaft seal	569942-1320	n=1
OTHER COMPRESSOR PARTS		-	-
13	Valve plate assy (front)	561420-2120	n=1
22	Valve plate assy (rear)	561420-2020	n=1
14,21	Suction valve	561410-1300	n=2

* see product description - Exploded view p.7

2. Oil

Item	Part name	Reference	Quantity
-	ZXL 100PG	569900-0600	250 cc

Notes

VALEO JAPAN - **TM31** for HFC-134a use
SERVICE MANUAL
Version: WW31-14011.01EN
Published by: VALEO JAPAN CO, LTD.

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For any inquiry regarding the present service manual,
contact us at vc-oura-sales@valeo.com

Valeo TM31 Compressor for Bus Air-Conditioning

Valeo TM31 Benefits

- High reliability
- Integration flexibility
- Great cooling capacity
- Enhanced performance
- Lower fuel consumption
- Compact & robust design
- Improved field serviceability
- Reduced noise and vibrations
- Staggering value through innovation

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www.valeocompressors.com

Asia
39 Sendai, Kumagaya-shi
Saitama-ken 360-0193 Japan
Phone: +81 (0) 48 539 3800
Fax: +81 (0) 48 539 3843
Email: vc-oura-sales@valeo.com

China
No.2677 Shiji Avenue, Eco. & Tec. Dvt
Zone 130031 Changchun, Jilin PRC
Phone: +86 (0) 431 8499 2025
Fax: +86 (0) 431 8499 2004
Email: vc-changchun-sales@valeo.com

Europe Middle East & Africa
8, rue Louis Lormand ZA de l'Agiot
78321 La Verriere, France
Phone: +33 (0) 1 3013 5027
Fax: +33 (0) 1 3461 5898
Email: vc-angers-sales@valeo.com

Americas
2520 Esters Blvd #100
Dallas, TX 75261 United States
Phone: +1 972 456 1077
Fax: +1 972 456 1090
Email: vc-dallas-sales@valeo.com

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